



# Managing Our Land Information Resources



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# Managing Our Land Information Resources

## Executive Summary

of the

Land Information Management Study

Prepared for the

Bureau of Land Management

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## PREFACE

The Bureau of Land Management (BLM) has initiated the development of a Land Information System to assist in the management of the land and resources for which the agency is responsible. This pioneering effort will draw together BLM's land records and natural resource information for a substantial portion of the nation. BLM has long recognized that this information is valuable to others. Concomitant with this has been the awareness that local, state, and other federal agencies hold additional information required by BLM for land management decisions and activities.

BLM has identified that an understanding of the linkages and mechanisms necessary to transfer land information between local, state, and federal levels of government and the private sector is crucial to the effective implementation of the Land Information System. The BSC Group - Surveying & Mapping, Inc (BSC) has been assigned the task of addressing these issues in a land information management study (Contract YA-551-CT8-440004). The principal objective of this study is to develop a base for broader cooperation, understanding, and involvement of the different levels of government and the private sector in the development of land information systems. The study comprised six major tasks, the last of which was to produce a final report which summarizes the findings and recommendations found in the previous tasks. That report is entitled, "Managing our Land Information Resources".

This document provides an executive overview of that substantial report.

In the final report and in this executive overview, the following working definitions have been adopted:

A land information system or LIS is a combination of human and technical resources, together with a set of organizing procedures, which results in the collection, storage, retrieval, dissemination, and use of land information in a systematic manner.

The Land Information System (LIS) being developed by BLM is based on a land information management concept that uses the Public Land Survey System to register, arrange, and organize land resource and land records information to the legal land parcel. The basic land information in this LIS includes:

- o Spatial information from the Public Land Survey System (PLSS). This information is administered in the Geographic Coordinate Database (GCDB).
- o Land conveyancing and tenure information including titles, rights, responsibilities and restraints (such as withdrawals) typically represented on master title plats. This information is to be found in the Automated Land and Minerals Record System (ALMRS).
- o Cultural and natural resource information which is managed in the Automated Resource Data (ARD) system.

A geographic information system or GIS is the technological component of a land information system, and comprises the hardware and software.



## EMERGING MODELS FOR LAND RESOURCE AND INFORMATION MANAGEMENT

### INTRODUCTION

The land -- wide open spaces and extensive resources -- is the foundation of the American culture and economy. Nearly every activity of society impacts the land and depends on the land as its base. As land use becomes more intense and complex, competition for specific tracts of land and for resource use is escalating. Despite the vastness of the land, there is a growing recognition that America's land resources are limited. Management of these resources is critical to sustaining both future economic development and the natural heritage. As noted by Udall (1963),

Each generation has its own rendezvous with the land, for despite our fee titles and claims of ownership, we are all brief tenants on this planet. By choice, or by default, we will carve out a land legacy for our heirs. We can misuse the land and diminish the usefulness of resources, or we can create a world in which physical affluence and affluence of the spirit go hand in hand.

The opportunities of tomorrow will be determined by the land-use decisions made today. Decisions concerning the allocation and use of the land are made routinely by private land owners, investors, developers, and agencies of all levels of government. To a large degree, these decisions are shaped by social, economic, and political values. But the effectiveness and efficiency of the decision-making process also depends on the information available to the participants.

It is not just a question of the quantity of information about the land that has been collected, but whether that information is accurate, accessible, and appropriate. Determining what information exists, where it is located, who owns it, and whether it can meet a user's needs is often a major problem in the decision-making process. Like the land itself, information must be recognized as a resource that requires explicit management to realize its full potential.



## **A NEW MULTI-USE LAND RESOURCE MANAGEMENT MODEL**

Land resource management may be defined as the art or science of making informed decisions about the allocation, use, and development of the earth's natural resources. It consists of four stages: policy development, planning, implementation, and monitoring. At each stage, efficient access to appropriate information is critical: information is the foundation from which land-related decisions are made, implemented, and enforced.

Land resource management is a multi-dimensional problem: yet those involved with it have usually taken a one-dimensional approach. These single dimensions include:

- o An **environmental** approach which views land resources as a delicate balance of elements;
- o An **economic** approach which views land and its resources as commodities; and
- o an **institutional** approach which views land resources in terms of aspects of group or social interaction that, in turn, influences our use of those resources.

In reality, all three approaches must be accounted for in multi-use land resource decisionmaking.

## **AN EVOLVING LAND INFORMATION SYSTEM MODEL**

As we become more concerned about managing our resources wisely, we also are developing a new understanding that managing information about the land is vitally important. Land information management is concerned with identifying, developing, and implementing appropriate responses to requirements for land information. What is emerging is a new LIS model that accounts for user requirements by attempting to understand how and what information is used in decision-making processes, how it flows from one user to another, and how a common language among users supports better decision-making. Moreover, the model accounts for the need to create policy-, systems-, and technology-related responses to those needs.



Fortunately, the evolution of computer-based land information systems has kept pace with the intensified need to manage increasingly complex resource issues. In the United States, we have evolved through two stages of LIS evolution and are now entering an important third phase. Stage 1 (1960-1975) saw the first uses of computers in surveying and mapping, automating land records, and development of urban and regional systems. Stage 2 (1975-present) has seen earlier computer systems being superseded by increasingly more powerful and flexible commercial geographic information and digital mapping systems.

Today, there are clear indications that we are entering a new stage focused on integrating databases and building distributed networks through which users can gain access to applications-oriented software tools for land resource management. In this new stage, we are less preoccupied with the systems themselves, and more focused on using information to manage land resources.

Several trends are emerging. There is more emphasis on shaping systems to meet the need for integrated resource management as well as greater appreciation of information as a resource that should be valued in its own right. Users are becoming more sophisticated, and everyone is moving away from monolithic systems to distributed systems that can run on smaller computers, yet communicate with each other.

## LESSONS FROM A HISTORICAL PERSPECTIVE

BLM wishes to embark on a systematic, continuous program of improving the management of land information, the success of which depends on the cooperation and support of other federal agencies, state and local governments, and the private sector. In an effort to learn from history, the study team assessed five land information studies which had achieved considerable fame at the time of their publication but that did not create or sustain progress over the longer term. These include:

- o "Land Title Recordation Practices: A State of the Art Study," for the U.S. Dept. of Housing and Urban Development in 1978 by Booz, Allen and Hamilton;



- o "Monitoring Foreign Ownership of U.S. Real Estate," prepared for Congress in 1979 by the U.S. Dept. of Agriculture;
- o "Effects of the National Environmental Policy Act on Corporate Decisionmaking" by Jack McCormick and Assoc., Inc. in 1978 for the U.S. Dept. of Commerce;
- o "Need for A Multipurpose Cadastre," in 1980 by the National Research Council;
- o "Procedures and Standards for A Multipurpose Cadastre," in 1983 by the National Research Council.

Despite their different focuses, all five suggested the same underlying concept -- improved land information based on a network of land information systems. The studies certainly enabled audiences involved with land management to familiarize themselves with fundamental concepts; however, they did not contribute to the emergence of a comprehensive, consistent network of LISS that enable information to be easily shared among them. We believe some reasons for the lack of progress were:

- o **Lack of Leadership** -- the federal government did not respond to these studies or use its expertise to work with others in developing policies, procedures, or standards for improving land information management.
- o **Lack of Authority** -- Those recommending the actions were not empowered to take action.
- o **Lack of Broad-based and Sustained Support** -- In most cases, the thrust behind developing an LIS or network was a single thrust, not enough to support the associated costs of such a network. Such a system must support multiple purposes if its costs are to be amortized economically and if it is to receive the requisite support over the many years of its useful life.
- o **Lack of Appropriate Skill Mix** -- Despite strides made by several institutions to train new personnel in the skills necessary to manage the technical and administrative aspects, skill-mix problems have hampered progress.



- o **Lack of Funding** -- Networked LISs require substantial up-front costs that go beyond the single need for which they are often conceived. Particularly at the state and local level, cost pressures are most often the largest obstacles to progress.
- o **Lack of an Institutional Framework** -- In general, the origins of most successful LIS efforts can be attributed to the unremitting effort of a single individual or champion. What is required for the creation of a set of networked systems, however, is an institutional framework, not a personal crusade. Indeed, most successful LIS ventures of any scale have been the result of sustained cooperation among various government partners.

## THE ROLE OF GOVERNMENT

What is also emerging is a sense that the role of government is pivotal to sustained progress in improved LIS and land resource decision making. Most land information has always been recognized as a public good. The Public Land Survey System (PLSS), geodetic control, land registries, topographic mapping, etc. are fundamental public services required for the security, stability, and economic well-being of society. Such programs would not have been developed without government support, and government must continue to help evolve the systems requisite for even more involved land information management. In reality, government is the largest producer and user of land information and the largest custodian of land information systems. Thus, government has the most to gain in fostering efficient access to accurate data and reducing unnecessary data collection, storage, and maintenance costs.

We believe that, ultimately, the effective management of land information can occur only through a partnership of federal, state, and local government, the private sector, and academia. But it must be government that lays the groundwork and supports the creation and maintenance of that partnership.



## TOWARDS A COLLABORATIVE PARTNERSHIP

### NEEDS OF LIS USERS

The study team interviewed a cross-section of people from federal, state, local governments, the private sector, and academia to assess the current needs of potential land information users. The requirements identified are presented here along with our view of the responses that will help meet those requirements.

- o **The Need for Direction** -- Many state and local government agencies are looking for guidance in planning their land information management programs. Where possible, lower tiers of government want to be compatible with activities of federal agencies, since the federal government is the largest single producer of land information and the largest custodian of land information systems.
- o **Need to Share Information** -- The creation of databases requires substantial labor, time, and money. Widespread agreement existed among those interviewed that duplication of data acquisition and maintenance must be avoided in favor of sharing data. This means that various agencies need to establish procedures for releasing information to other potential users. This, in turn, implies that agencies must not feel proprietary about the data they have amassed.
- o **Need For Coordination** -- We saw increased awareness of the need for coordination among agencies. The need to coordinate activities and to learn from one another is driven by similar environmental, economic, political, and administrative problems experienced by agencies at all levels of government.
- o **Need for Knowledge** -- In many jurisdictions, those charged with establishing LISs have limited experience with land information or computer systems. They eagerly seek information about concepts, applications, and technology as best they can, predominantly from conferences, which, while valuable, are not the ideal mechanism for education of this magnitude. Also, people



want to know what their peers are doing, so that they can capitalize on work already accomplished.

- o **Need for Funding** -- Given tight cost constraints, organizations at all levels are looking for funding sources as well as ways to minimize duplication of costs.

## **RESPONSES REQUIRED TO MEET USER NEEDS**

- o **Leadership** -- The federal government needs to provide the leadership necessary to develop land information management policies, priorities, and standards, as well as monitor activities. At the federal level, various agencies should be identified to support state and local government through public programs.

States, in turn, should be encouraged to designate an entity for coordinating roles and responsibilities, as well as for establishing standards and procedures for collecting, storing, retrieving, using, and distributing land information. For instance, states might find it useful to adopt or amend model laws that have been created previously by land management and legal experts.

- o **Standards** -- The efficient exchange of land information is dependent upon standards for information and data communication. Some standards have been voluntarily adopted by groups hoping to share information on a consistent basis. Some attention has been directed towards standards for terminology and definitions, database documentation, spatial referencing systems, linkage and indexing systems, classification and interpretation schemes, communication and interchange formats, and attributes of data. However, much of the work has been fragmented. The new model for land information management requires that hardware, software, data and applications standards be integrated more formally.

- o **Corporate Data and Custodianship** -- In a multi-user LIS environment, it is necessary to re-evaluate how information is perceived. Historically, information has been seen as property belonging to the acquiring agency. Such distinctions disappear if each group views its role



as being responsible for holding the land information in trust for the citizens, i.e. the taxpayers who fund the data acquisition in the first place.

- o **Institutional Aspects** -- The federal government should provide institutional support in facilitating state and local systems development, conducting research and development, and helping to coordinate these programs. By clearly setting the broader view and supporting long-term programs rather than short-term projects, the federal government can help all participants retain the broader perspective regarding the contribution they are making to a national program. Also, the federal government might sponsor the creation within the states and municipalities of Offices of Land Information Systems. If cost constraints inhibit such offices, the government could support the efforts of present groups such as state Geographic Information Systems User Groups and State Mapping Advisory Committees to fill that need.
- o **Education** -- Many LIS developers and users have had to train themselves in the basics. This has often resulted in fostering the single-dimension approach to resource management. The federal government should actively encourage continuing education programs through leading universities as vehicles for people to upgrade their skills and knowledge.
- o **Communication** -- Communication amongst users of LISs is critical and needs to be addressed at two levels. At the organizational level, source agencies and users need to understand their role in the process of what to expect. In multi-organizational efforts, clear open lines of communication are even more critical. Annual symposia and meetings can provide valuable forums for keeping all parties informed.

At the technical level, it is imperative that separate systems are designed so that they can communicate and share information. What's more, the information should be referenced to the same maps or datums, otherwise the cost of transformation might well prevent data sharing.

- o **Cost Identification and Recovery** -- Although costs and benefits are often the bottom line for a program, neither the costs nor benefits of an LIS is well understood.



Research is needed to clarify how that type of analysis can better be applied to LIS development. Also needed is federally-sponsored work into evaluating how the high costs of creating, maintaining, and sharing land information can be recovered by users in an effective manner.

## **NEW ROLES FOR THE FEDERAL GOVERNMENT**

The interaction and collaboration of federal agencies is critical if the actions described above are to occur. Many federal government agencies have embarked on land and geographic information system initiatives in response to mounting pressures. The present and future land information management requirements of the United States are of such immense proportion and varied natures that these agencies need not be in competition with one another. Instead, the action of federal agencies can and must be complementary.

Federal agencies are rising to the challenge. An example of this new era of collaboration is the 1988 Memorandum of Understanding which provides the basis for cooperative efforts in surveying, mapping, geodesy, and land information system development between BLM and the National Oceanic and Atmospheric Administration. In particular, the organizations seek to build the human and institutional resources necessary for the development and implementation of land information systems, recognizing that this is a long-term, complex process requiring significant investments.

Another collaborative effort of significance is the Memorandum of Understanding establishing the Northwest Land Information System Network, a partnership currently of 19 federal and state agencies in Oregon and Washington, of which BLM is also a part. This network was initially promoted by the BLM Oregon State Office as a vehicle to share digital data between resource management agencies. The Network's charter specifies a long-term program direction which encourages the sharing of data and system resources, and calls for an assessment of the feasibility of an integral regional database.

Our future challenge lies not with developing larger databases or new technology, but with using our land



information resources more effectively in the wise management of our land resources. To transform these concepts into effective action, a partnership of federal, state, and local governments, the private sector, and academia is needed.

Federal agencies whose charters focus on land management or land information must begin an on-going collaborative effort to draw together local and state governments, as well as the private sector and academia into a working partnership. These players must develop the "big picture" or conceptual models, as well as the details necessary to implement preliminary programs which integrate natural resources information with land records.

Local governments play a key role in building and maintaining comprehensive land information systems. Despite this, development of such systems at the local level has been infrequent, partly because longer-term perspectives seldom prevail when single-year budget cycles and periodic political upheaval limit efforts to single-purpose systems that serve immediate needs.

Federal initiatives in support of more comprehensive modernization efforts at the local level should be focused initially on better aggregate data or better access for information required for federal purposes. Two federal roles can be indentified: first, as an information provider/ analyzer/user, and secondly, as a model and resource for local and state projects requiring technical expertise on issues such as control and standards.

States provide an additional perspective. Each state has the independent authority to regulate land records and legal activities involving land tenure through legislation, and each state already has intimate legislative and administrative ties to its counties, parishes, and municipalities. Consequently, direct federal involvement can be focused on only 50 lines of essential communication rather than on thousands.

Land information management requires research and development, as well as the collection and processing of the information. The private sector, and the university community should play important supporting roles. These sectors are more innovative, and new services, products, and concepts will probably come from their initiatives. But



there is a need for the federal government to provide the institution framework within which these innovations can be coordinated and directed to meet user needs more equitably. Such a partnership should develop standards for hardware, software, data and applications as well as three types of models:

- o A multiple-use land management planning model for use by federal, state, local government and the private sector;
- o A parcel-based LIS model that can be applied to publicly- and privately-owned land.
- o Model legislation which reinforces land information systems and practices, and which could be used by state and local governments.

Additionally, such a partnership should take the lead in promoting communication and education among participants, and promoting research and development. It is through the partnership that long-term efforts, multi-purpose goals, multi-agency involvement, multi-purpose funding, and legislative support could be achieved.

#### INSTITUTING MODEL PROGRAMS

A key ingredient to improving the management of land information is the development of large-scale, accurate land information systems which allow the integration of parcel (or institutional) information with natural resource (or environmental) information. Local governments are key, since they are the focal point of much land information activity. The "bottom-up" approach calls for large-scale, accurate land information collected by local governments to flow upwards, as required, to the state and federal levels of government. Mechanisms established to facilitate this upward flow of information would also be available to move information contained in federal databases down to state and local governments.

Instead of pilot projects, we propose that such proving grounds be considered preliminary programs to be expanded into full-fledged multi-user, multi-purpose programs over time. The standards and models should be tested in



preliminary programs in a number of geographically and culturally different jurisdictions in order to identify issues common to users across the nation. These programs must be based on demonstrated land management needs and should involve local governments which have already demonstrated a commitment to improving land information management by investing their own resources. These programs should build on the results of programs such as the Resource Management Plans developed by BLM, and they should be well advertised throughout the nation, and open to inspection so that others may use the knowledge gained to implement their own systems.

### **BLM RESPONSIBILITIES AND RESPONSES**

During the course of this study, it became evident to the study team that BLM has already made substantial headway in specifying an LIS model that is responsive to users' needs. What's more, BLM has also implemented cooperative efforts with other agencies out of which some very innovative and useful land management activity has emerged.

### **BLM'S CHARTER**

BLM's activities are extensive, not only in terms of the land area being managed, but also with respect to the diverse and often conflicting demands regarding the use of the land. BLM has direct responsibilities in about one-quarter of the United States; the agency manages approximately 275 million surface areas and another 300 million acres of mineral rights.

BLM's sphere of influence is considerable throughout the country. The agency is responsible for cadastral surveys on all federally owned land (about one third of the nation). Furthermore, the Public Land Survey System (PLSS) which was created in 1785 is recognized as the framework for the establishment of LISs by many counties in the western and midwestern states.



BLM is directed by the Federal Land Management and Policy Act (PL 94-579) which specifies that the public lands be managed in a manner which:

- o Recognize the nation's need for domestic sources of minerals, food, timber, and fiber from the public lands;
- o Protects the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water, and archeological resources;
- o Preserves and protects certain public lands in their natural conditions where appropriate; and
- o Employs as a basis, the principles of multiple use and sustained yield unless otherwise specified by law.

Furthermore, to the extent consistent with the laws governing the administration of the public lands, BLM is required to coordinate the land use inventory, planning, and management activities relating to these lands with comparable programs of other federal agencies, and with those of the state and local governments within which the lands are located.

This concept of stewardship is presently being underscored within BLM. The Bureau has re-affirmed its belief that all people are linked to, and dependent upon, the land and its resources. That is, despite the political, administrative, and technological changes that continue to affect our society, our life support system is the planet Earth. BLM therefore sees its role as a steward of much of the nation's land.

#### **THE BLM LAND INFORMATION SYSTEMS MODEL**

BLM supports and encourages a land ethic of wise use and conservation of our land and its resources for the benefit of our current population, and for the generations still to come. They recognize too that improved land information management is crucial to making successful decisions about how to use our natural bounty effectively and yet still preserve future capabilities. To achieve these goals, BLM is pioneering an automated LIS which will draw together land records and natural resource information for the first time.



Development and implementation of the LIS guided by the principles that:

- o BLM manages information, as well as lands and resources, as valuable public assets;
- o BLM shares information with others in support of agency missions; and
- o Computer-based tools can help BLM personnel to be more responsive to the needs of society.

The LIS comprises three elements:

- o The Geographic Coordinate Database (GCDB) system which contains coordinates of the PLSS corners;
- o The Automated Land and Mineral Records System (ALMRS), which provides information about legal land descriptions, ownership status, special designations, and use authorizations; and
- o The Automated Resource Data (ARD) System, which manages information about the cultural and natural resources of land administered by BLM.

The study team interviewed a variety of BLM personnel who identified numerous benefits of such an LIS. Some of these include: the use of high-quality data, the ability to be more responsive because of the automated system, productivity potential, the opportunity to make well-informed decisions, and the ability to bring new personnel up to speed more rapidly.

#### **PARTICIPATION WITH OTHERS IN DEVELOPING THE LIS**

It is our view that BLM has already engaged other agencies in a way that, if continued, can support improved land resource management throughout the country. Two major examples of such cooperation are the Boise Interagency Fire Center in Idaho and the Northwest Land Information Systems Network mentioned earlier.



The Boise Interagency Fire Center was established in 1965 as a cooperative venture of six federal agencies to improve coordination of fire-support activities among federal and state firefighting agencies. The Northwest Land Information Systems Network was established in 1987 through a multi-agency Memorandum of Understanding to provide a means for sharing digital resource data among many federal, Oregon and Washington resource management agencies.

### **Working With Other Agencies**

BLM has played a key role in drawing agencies together. The success of both ventures is due to several crucial factors. Both grew out of the need and willingness for joint participation. They have prospered because there has been a high level of sustained commitment to the programs and because of a common base of interest. Equally important has been the fact that both activities were staffed by qualified personnel who continue to focus their collective efforts. This type of collaboration will continue to be critical as BLM calls for participation on the part of other agencies and organizations is shaping its LIS. As BLM has evolved to meet the requirements of its charter, and as priorities have been identified in terms of responsibilities for managing land information, they have perceived an increasing need to collaborate with other agencies and organizations. Many of the environmental, economic, political, and administrative complexities facing BLM managers are also being encountered by local, state, and other federal agencies. For example, there is an increasing awareness of the need to adopt a holistic approach to land management. Land within a catchment area may be administered by federal, state, and local governments, and private owners. In other cases, BLM, together with several other agencies, may jointly share the responsibility for the management of a tract of land.

New computer and telecommunications technologies have further underscored the need for agencies to cooperate. In addition to BLM, a number of agencies are investing in spatial information systems. Creation of databases for these systems requires substantial labor, time, and financial resources. In many cases, BLM and other federal, state, and local government agencies share similar needs for information. There is widespread agreement that the costs of creating databases must be offset by minimizing duplication of data collection. Coordination and cooperation extend beyond the



task of the initial creation of the databases. The need to share common data sets because of interrelated operational, management, and policy level decision-making concerns will continue to drive the on-going transfer of information between agencies.

Responses from our interviews with representatives of federal, state, and local governments, the private sector, and academia unequivocally reinforce the value of the LIS being developed by BLM. The LIS is unique in that it reflects the land management and cadastral responsibilities of the Bureau: the system contains natural and cultural resource information, land registration information, and cadastral survey information. Within the pilot project areas of New Mexico, Wyoming, and Oregon, keen interest has been shown by the full spectrum of possible users in using the new land information products. Consequently, it is probable that, as the LIS is implemented elsewhere, the availability of the information will be met with strong demand.

#### **Working With State and Local Governments**

States are in a key position to develop and influence LISs. In an increasing number of states, BLM personnel have served on both formal and ad-hoc committees established to coordinate land information management activities. In the western states, many agencies share their data with BLM and draw on BLM as a matter of course in their operations.

At the local level, cooperation among BLM and local governments extends beyond database creation. Cadastral surveys performed by BLM are recorded with local governments. Further, BLM is required to coordinate land-use inventory, planning, and management activities with that of local governments within which BLM managed lands are located.

#### **Working With the Private Sector**

The private sector can play an important role in providing BLM with the massive amounts of data it requires for its three LIS components. BLM can avoid investing in necessary labor and technology by drawing on the capabilities of the private sector for the data gathering phase. The private sector is also in a position to provide BLM with private data on land that abuts BLM managed land.



## Working With Academia

BLM's LIS is a complex system that will interact with all aspects of society. Applied research on the impact of such a system could focus on managerial, institutional, economic, legal, and technical issues -- all of which could be well addressed by the academic community in collaboration with BLM. These activities should be coordinated and directed within an institutional framework. A potential model is the Northwest Universities Network, which is an integral part of the Northwest Land Information Systems Network currently being developed in Oregon and Washington. Specialized data can also emanate from universities, as was the case when the University of New Mexico shared valuable archeological data with BLM.

## CALL TO ACTION FOR BLM

Effective management of land information can occur only through a partnership of federal, state, and local governments, the private sector, and academia. This broad partnership can be developed only with leadership by the federal government. However, a catalyst is needed to stimulate this leadership. State and local governments cannot wait any longer; yet, their individual efforts at improving land resource management through individual, isolated land information systems will not result in an integrated land information network. What is needed is a sustained amalgamating effort around which different groups can readily share accurate, consistent information about the land. We believe that BLM should act as this catalyst for change by encouraging federal, state, and local agencies to participate in coordinating land information activities. We also believe BLM should participate actively as a member of the broader partnership once it has been established.

While not widely publicized, BLM has already undertaken action of the sort expected by the federal government. The Bureau has developed a land information system model which supports multiple-use land management. This model, we believe, can be used by agencies responsible for land information and land management throughout the nation. BLM has also developed a proven model for participation and



interaction by a variety of land information and land management agencies.

We believe that BLM is well positioned to make a significant contribution towards improving the management of land information:

- o As a manager of land -- BLM can share its expertise gained from efforts to improve its own information management. Through its mandate to provide for multiple use, BLM has had to weigh its decision in terms of all potential consequences -- environmental, economic, and institutional. And as a user agency, BLM can contribute its experience in not merely producing information, but in responding to management needs for information.
- o As a manager of spatial data -- BLM can contribute its skills in maintaining spatial data, for example, in the form of master plats and other surveying and mapping products, and its experience in integrating this information with textual land records.
- o As the custodian of foundation information -- BLM can contribute its skills in managing the land tenure system. In thirty states, the PLSS is recognized as a basic framework for any multi-purpose land information system. Not only did the Bureau, in effect, create and implement the PLSS, but through its current efforts in creating its LIS, the agency can demonstrate how the PLSS can be revitalized.
- o As an active partner with other government agencies -- BLM can contribute its expertise in responding to joint management issues. BLM has forged both mandated and voluntary working relationships with other federal, state, and local governments.
- o As an active partner with academia -- BLM can contribute its experience in promoting education. BLM's role in developing a surveying/land information systems program at New Mexico State University, and the Bureau's cooperative programs with other universities, are increasing the number of land information and land management specialists.



## NECESSARY NEXT STEPS

BLM should not only continue to pursue these activities but should broaden its horizon to interact with more groups, and to communicate these activities more widely. We recommend that BLM undertake the following actions:

- o Establish an Office of Land Information Management. This office should coordinate BLM's land information management activities over the long-term, first in its role as a catalyst, and then as a partner.
- o The Office of Land Information Management should establish two internally-focused task forces, both with a six-month deadline. The Office should notify other federal agencies, as well as other interested parties, about the task forces.

The first task force should:

- o Identify issues which affect the development of Bureau-wide standards relating to hardware, software, data, and applications with particular emphasis on the integration of institutional (parcel-based) and natural resource information;
- o Identify internal educational processes to upgrade land information management knowledge and skills of its personnel. In this regard, BLM should re-assess its educational curriculum so that concepts and applications for multiple-use of land and land information systems are communicated to its personnel through vehicles such as the Phoenix Training Center;
- o Identify external educational processes to increase the numbers of well-trained land information and land management specialists available to BLM. BLM should expand its existing cooperative and study programs with universities and should introduce national scholarships for students in the field of land information management; and
- o Identify the mechanisms required to establish a research agenda.



The second task force should:

- o Identify mechanisms for communicating the concepts of land information management to the entire land information community within BLM; and
- o Identify obstacles that prevent outside users as well as those within BLM from obtaining BLM land information.

The Office should communicate the findings of the task forces to other federal agencies within two months of completion. It should also use the workshops and forums designed to communicate the results as a base to promote the concepts of coordinated leadership by federal agencies. Beyond these task force efforts, BLM should build on existing relationships with other agencies and expand on mechanisms such as the Memoranda of Understanding already in force.

## CONCLUSION

BLM has acquired tremendous knowledge and experience in effectively managing the multiple-use of millions of acres of U.S. land and the resources thereon. It has developed a vision of how to integrate innovative multiple-use land management concepts within a multiple-purpose, state-of-the-art land information system. And, it has served as a catalyst on a regional basis to engage government agencies and other groups to work successfully in improving land management.

BLM, we believe, should continue to pursue all three activities -- 1) managing land for multiple-use, 2) creating an LIS to support multiple-use land management, and 3) serving as a catalyst on a regional basis to improve land management. We believe, however, that BLM also has an obligation to help forge a new, broad-based partnership -- one that will promote better management of land use and land information throughout the United States. Without question, it should be by choice, not default, that we "carve out a land legacy for our heirs."



# **Managing Our Land Information Resources**

## **Report**

of the  
Land Information Management Study  
Prepared for the  
Bureau of Land Management

By

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LAND INFORMATION MANAGEMENT STUDY  
(Contract YA-551-CT8-440004)

Report on Task 6:  
MANAGING OUR LAND INFORMATION RESOURCES

This study describes the work performed for the Bureau of Land Management (BLM) by the BSC Group - Surveying & Mapping, Inc (BSC) in fulfillment of Task 6 of its contract with Computer Technology Associates, Inc (CTA).

1. INTRODUCTION

1.1 The Land Information Management Study

The Bureau of Land Management (BLM) has initiated the development of a Land Information System to assist in the management of the land and resources for which the agency is responsible. This pioneering effort will draw together BLM's land records and natural resource information for a substantial portion of the nation. BLM has long recognized that this information is valuable to others. Concomitant with this has been the awareness that local, state, and other federal agencies hold additional information required by BLM for land management decisions and activities.

BLM has identified that an understanding of the linkages and mechanisms necessary to transfer land information between local, state, and federal levels of government and the private sector is crucial to the effective implementation of the Land Information System. The BSC Group - Surveying & Mapping, Inc (BSC) has been assigned the task of addressing these issues in a land information management study. The principal objective of this study is to develop a base for broader cooperation, understanding, and involvement of the different levels of government and the private sector in the development of land information systems.

In order that this objective be achieved, six tasks have been specified. They are to:

1. Describe the processes required for BLM to successfully exchange and transfer land information with local, state, and federal agencies, as well as organizations within the private sector.
2. Assess identified land information management studies in terms of their impact on the processes most appropriate to the exchange of land information between local, state, and federal governments, and the private sector.
3. Develop a description of the specific actions that will be required by local, state, and federal governments, and by professional institutions and organizations in the private sector and academia to facilitate the necessary linkages and mechanisms required for the exchange and transfer of land information.
4. Develop scenarios that describe appropriate participation and input from various levels of government to ensure that the actions, initiatives, and levels of cooperation recommended are tested and documented.
5. Describe the roles and levels of participation of local, state, and federal governments, private sector firms, and academia in the development and use of an integrated land information system proposed by BLM.
6. Produce a final report which summarizes the findings and recommendations found in the previous tasks.

#### 1.2 Structure of the Report

This report addresses the requirements of the sixth task, i.e., it is a synthesis of the findings of the five earlier tasks. However, in order to convey more clearly the concepts of land information management, the information in this report is presented in the following way. Section 2 describes the changing needs and responses of society in terms of a new understanding of land information management that is emerging. Section 3 gives a historical perspective of key initiatives to improve the management of land information. Section 4 discusses the need for a collaborative approach to the management of land information. Section 5 evaluates the activities of the Bureau of Land Management in light of



this re-assessment of land information management. Section 6 presents recommendations and conclusions.

The report is based, in part, on meetings held with representatives of federal, state, and local government agencies, private sector consultants and corporations, and universities. We recognize that the research is not exhaustive since project constraints limited the number of interviews conducted. Nevertheless, the responses solicited were drawn from a broad cross-section of participants.

### 1.3 Terminology

We discussed the Land Information Management Study with representatives of various federal, state, and local government agencies, the private sector, and academia. During the discussions, we asked the representatives to give their interpretations of the terms "land information system" (LIS) and "geographic information system". As expected, there was a considerable variation of interpretations by the different agencies and even within BLM. Definitions given include:

- o LIS is the umbrella term which includes GIS, data, and people; GIS is the technology or tool.
- o GIS is a computer hardware and software system designed to collect, manage, manipulate, analyze and display spatially referenced data. (Federal Interagency Coordinating Committee on Digital Cartography (FICCDC), 1987).
- o GIS is the computer hardware/software used to input, store/retrieve, manipulate/analyze, display, and plot/print spatially referenced digital data (e.g., digitized maps, remote sensor, tabular data, etc.). Thus a GIS is comprised of three essential subcomponents: computer hardware, computer software, and various types of digital data. (American Society for Photogrammetry and Remote Sensing, (ASPRS)).
- o LIS is a multi-purpose, large-scale, system with accurate information; GIS is a single-purpose system of low spatial accuracy.
- o LIS deals with land parcel data and ownership; GIS deals with natural resource management.



- o GIS is the umbrella term which includes spatial referencing and analytical capabilities; LIS involves data collection and inventory.

These widely varying and sometimes conflicting interpretations of the same terms have resulted in frustration and confusion at times. There is a need for those working in the field of land information management to reach a common understanding of these terms.

It is not the intention of the study to debate the merits of the various labels, but rather to concentrate on the actions required to improve the management of land information. To avoid misinterpretation, however, the following working definitions have been adopted for the purpose of this Land Information Management Study:

- a) A land information system is a combination of human and technical resources, together with a set of organizing procedures, which results in the collection, storage, retrieval, dissemination, and use of land information in a systematic manner.

The Land Information System (LIS) being developed by BLM is based on a land information management concept that uses the Public Land Survey System to register, arrange, and organize land resource and land records information to the legal land parcel. The basic land information in this LIS includes:

- o Spatial information from the Public Land Survey System (PLSS). This information is administered in the Geographic Coordinate Database (GCDB).
- o Land conveyancing and tenure information including titles, rights, responsibilities and restraints (such as withdrawals) typically represented on master title plats. This information is to be found in the Automated Land and Minerals Record System (ALMRS).
- o Cultural and natural resource information which is managed in the Automated Resource Data (ARD) system.

- b) A geographic information system is the technological component of a land information system, and comprises the hardware and software.



## 2. LAND INFORMATION MANAGEMENT: TOWARDS A NEW UNDERSTANDING

### 2.1 Introduction

Concern about the land is re-emerging as a theme in the political and social agenda in the United States. One response has been the identification of the goal of "sustainable development". Such a goal implies an integrated approach to land management which facilitates development but in a manner "that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987). Allied with this, is an increasing awareness by those responsible for developing land information systems that the fundamental issues lie not with information per se, but with how the information can play a more effective role in decision-making.

Section 2.2 describes the development of shared understanding of the problems related to integrating the environmental, economic, and institutional aspects of resource management, and the development of a shared information base. Section 2.3 portrays the evolution of computer-based land information systems as a response to these challenges. Section 2.4 describes the emerging view of husbanding our land information resources to support effective decision-making and land management. Section 2.5 identifies some of the issues which must be addressed for these concepts to be transformed into meaningful action.

### 2.2 Present Challenges

#### 2.2.1 Management of Land and Information

The land -- wide open spaces and extensive resources -- is the foundation of the American culture and economy. Nearly every activity of society impacts the land and depends on the land as its base. As land use becomes more intense and complex, competition for specific tracts of land and for specific resource uses is escalating. Despite the vastness of the land area, there is an emerging recognition that America's land resources are limited. Management of these resources is critical to sustaining both future economic development and the natural heritage. As noted by Udall (1963),



Each generation has its own rendezvous with the land, for despite our fee titles and claims of ownership, we are all brief tenants on this planet. By choice, or by default, we will carve out a land legacy for our heirs. We can misuse the land and diminish the usefulness of resources, or we can create a world in which physical affluence and affluence of the spirit go hand in hand.

The opportunities of tomorrow will be determined by the land-use decisions made today. Decisions concerning the allocation and use of the land are made routinely by private land owners, investors, developers, and agencies of all levels of government. To a large degree, these decisions are shaped by social, economic, and political values. But the effectiveness and efficiency of the decision-making process also depends on the information available to the participants.

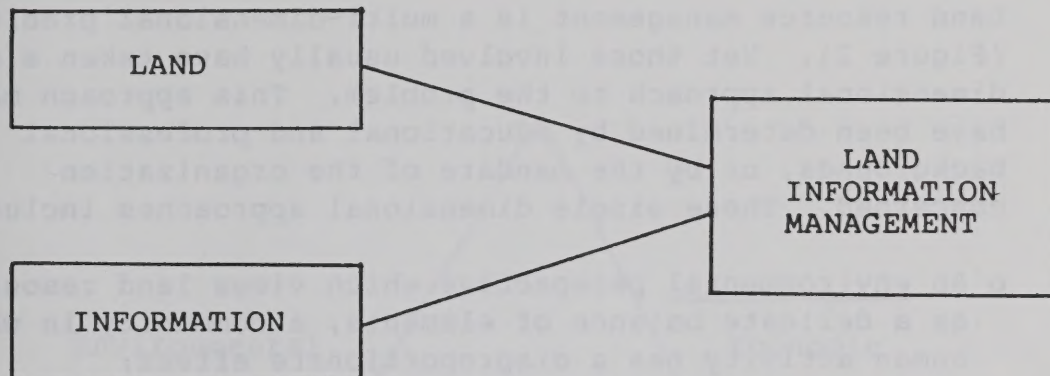
It is not just a question of the quantity of information about the land that has been collected, but whether this information is accurate, accessible, and appropriate. Determining what information exists, where it is located, who owns it, and whether it can meet a user's needs is often a major problem in the decision-making process. Like the land itself, information must be recognized as a resource that requires explicit management to realize its full potential (Figure 1).

#### **2.2.2 An Interdisciplinary Approach**

Land resource management may be defined as the art or science of making informed decisions about the allocation, use, and development of the earth's natural resources. It consists of four stages: policy development, planning, implementation, and monitoring. At each stage, efficient access to appropriate information is critical; information is the foundation from which land-related decisions are made, implemented, and enforced.

Without the required information, the management process becomes ineffective. Decisions are delayed, problems and opportunities are often overlooked, planning is reduced to guesswork, and the management process can become a series of ad-hoc responses to crises. This relationship between land information and the management





**Figure 1: The inter-relationship of land and information.**

process is often not explicitly recognized, but, as one senior government official has noted:

Without accurate information about the lands and waters, and without an up-to-date inventory of a country's land resources and what is happening to them and the environment, the government and the people are handicapped in controlling their own destiny. It is not possible to make the best use of the land and natural wealth, or to prevent its mis-use, without good factual knowledge of the country and its features. (Root, 1985).

Land resource management is a multi-dimensional problem (Figure 2). Yet those involved usually have taken a one-dimensional approach to the problem. This approach may have been determined by educational and professional backgrounds, or by the mandate of the organization concerned. These single dimensional approaches include:

- o An environmental perspective which views land resources as a delicate balance of elements, a community in which human activity has a disproportionate effect;
- o An economic perspective which views land and its resources as commodities, the basis for economic wealth, with market-driven development being the goal of land management; and
- o An institutional perspective which views land resources in terms of the various aspects of group or social interaction which influence or control our use of these resources. The institutional dimension often receives less attention than the other two, but it is through such institutions as the legal system, the family, and property that resource policies are eventually implemented.

To view land resource management from only one of these perspectives is counterproductive in the long run. Land use decisions must be weighed in terms of all potential consequences -- environmental, economic, and institutional. As Udall (1963) has noted,

Our mastery over our environment is now so great that the conservation of a region, a metropolitan area, or a valley is more important, in most cases, than the conservation of a single resource. Complex decisions will require sophisticated judgements that weigh all elements and explore all alternatives...As the



Environmental

Economic

Institutional

Figure 2: Three Facets of Land Management

area of conflict and overlap increases we must constantly improve our decision-making techniques.

Such an interdisciplinary approach has a direct impact on information requirements. Many more variables have to be considered at each stage of the management process, and thus a wide variety of information is required. In addition to site-specific information, there is a growing need for consistent information at the regional and even national level for evaluating the potential impacts of projects and programs and for monitoring their implementation.

Developing a shared understanding of the problems and a shared information base requires increased capabilities, for example in integrating and relating environmental, socio-economic, and institutional information in both graphical and textual formats. Problems such as using different spatial referencing systems and using information collected at different scales, resolutions, and reliability will have to be resolved before information can be readily and effectively combined. Information standards must also receive more attention by source agencies to prevent and/or resolve some of the data-integration problems.

### 2.3 An Evolving Land Information Management Process

In a real sense, we have traveled through two stages of the evolution of computer-based land information systems. There is increasing evidence that we are entering a third stage of the process.

#### 2.3.1 Stage 1 (circa 1960 - 1975)

The early 1960's witnessed the first uses of computers in surveying and mapping, the first efforts at automating land records, and the first attempts to build urban and regional systems. This period represented the preliminary 'learning years' in land information systems.

For the most part, the early systems were housed in large organizations and were used primarily for textual data which required routine processing. A popular concept that emerged at this time was the centralized land data bank. The first generation systems developed, such as the ROMTRAN urban information system (sponsored by the



U.S. Department of Housing and Urban Development) and MIADS (a landscape information and display system developed by the U.S. Forest Service), tended to provide information to specialized resource planning communities. Furthermore, these systems had only limited geographic representation, file structure, data storage, and processing capabilities.

### 2.3.2 Stage 2 (circa 1975 - present)

Beginning in the mid-1970's, the early computer systems were superceded by increasingly more powerful and flexible commercial geographic information and digital mapping systems. Computers became more powerful, smaller, less expensive, and therefore more accessible to a larger group of potential users. Along with the advances in technology, there were major initiatives regarding land records improvements (beginning with the Real Estates Settlement Procedures Act (RESPA) and MOLDS, the Modernization of Land Data Systems), as well as a growing interest in environmental databases and automated mapping/facilities management.

The emphasis in the second stage has been on the integration of map-based and textual land records, as illustrated in the multi-purpose cadastre concept (National Research Council, 1980) and by the CAMRAS programs sponsored by the American Public Works Association. Forest management and other environment-related applications also helped to spur the development of more sophisticated geographic information systems with capabilities for modeling and analysis. At the same time, the need for institutional support has become increasingly recognized as some early systems foundered and as the problems of integrating data held in a proliferation of computer systems became more evident.

### 2.3.3 Stage 3

As we respond to the challenges facing us, there are clear indications that we are now entering a third stage. In this new stage, the focus will increasingly be on integrating databases and building distributed networks, and on developing application-oriented software tools. Underlying these efforts will be a renewed concern about



the effective development and management of our resources.

While the details of this third phase are not yet apparent, it is clear that we are moving:

- o Away from merely developing tools in the form of geographic information systems;
- o Into a data-rich environment as we invest millions of dollars in building databases; and
- o Beyond tools and data as we focus on the use of information in managing our land resources.

These observations are based on the following identified trends:

- a) Changing requirements for land information.  
Increasing attention is being focused on integrated resource development and management consistent with a renewed concern about the environment. Earlier, we identified the need to view development from environmental, economic, and institutional perspectives.
- b) Growing appreciation of costs.  
An appreciation for the importance of treating information as a corporate resource is slowly emerging -- an organization responsible for collecting and maintaining information is being seen more as a custodian and not an owner of the information. Cost containment, if not cost reduction, has become a major issue at all levels of government, and one of the greatest costs identified in managing land information is that associated with duplication of data collection, storage, and services. While some duplication may always be necessary, it is being greatly reduced by policies and programs which promote information exchange and sharing. There is an increasing perception that data collection programs and information products should be coordinated to meet the needs of as many users as possible.
- c) Growing sophistication of the user community.  
The user community is becoming increasingly knowledgeable about technological requirements. This community, too, is gaining an increased understanding



of the potential role of information in the decision-making process.

d) Growing movement towards distributed information networks.

Requirements for information systems are becoming more diverse and sophisticated. In many cases, these requirements are being met on smaller computers. The migration from mini-computers to micros and from mainframes to mini-computers is making specialized systems available for a wider user group. Both clients and vendors are moving away from turnkey systems to more tailored software and hardware modules which meet specific user requirements.

Simultaneously, the need to rationalize computer facilities and data collection programs and the need to provide access to, and the integration of, a greater variety of data have led to the concept of linking systems together in distributed land information networks. A major consequence of building networks is that an even greater focus is required on policies and standards affecting not only hardware and data exchange, but also how information is collected, classified, represented, and maintained in a multi-user environment.

#### 2.4 Towards a New Model of Land Information Management

Wise management of the land and its resources requires proper management of information about the land. As a response to concerns about the land and its resources, a new understanding of land information management is developing -- that of husbanding and marshalling our land information resources in support of effective decision-making.

Land information management is concerned with identifying, developing, and implementing appropriate responses to the requirements for land information. At one level, it involves implementing information technologies. At a higher level, there is a need for system-related responses which provide the technical, personnel, and organizational support for projects and programs. At another level, land information management is concerned with the development of policies to guide,



regulate; and support systems. Policy-, systems-, and technology-related responses are inter-related parts of an overall land information management strategy (Figure 3). The following sections describe these concepts as they relate to an emerging model of land information management.

#### 2.4.1 User Requirements

If the effectiveness of a land information strategy depends on how well it meets information requirements, then these requirements must be identified, understood, and evaluated. Traditional benefit-cost studies and the generic user-needs questionnaires and inventory approaches have invariably failed to identify why information is required. Instead, time and effort must be invested to develop:

- o An understanding of how information is actually used in the decision-making processes;
- o An understanding of how information flows from one producer to another;
- o An understanding of constraints in the information-flow process;
- o A common language among users; and
- o A common understanding of the land information products.

These cannot be achieved without the involvement of users from all levels and sectors.

#### 2.4.2 Policies

Policy-level responses focus on developing priorities, assigning responsibilities and resources, setting standards, and monitoring activities. Policies provide for the institutional support required in the creation, development, and operation of land information systems and technology. Policies may be narrow, for example, addressing specific issues such as land information classification schemes or computer acquisition. On the other end of the spectrum, policies may establish organizational mandates and financial or legislative support. Policies in other areas may also have an impact on land information management as, for example, those concerning access to information or privatization.



Needs → Responses

INFORMATION REQUIREMENTS	POLICIES
	SYSTEMS
	TECHNOLOGY

Figure 3: A land information management model.

#### 2.4.3 Systems

System-level responses concentrate on specifying, implementing, managing, and evaluating new programs and technologies designed to improve the availability and use of land information. A system is a means of organizing components and processes. A land information system can therefore be defined as a combination of human and technical resources, together with a set of organizing procedures, for managing the collection, storage, processing, dissemination, and use of land information. Organizing procedures may include standards for the content, referencing, and display of information. They also encompass the development of implementation plans and the allocation of responsibilities. From administrative structures to data structures, it is this systematic organization of resources and activities that creates a land information system.

#### 2.4.4 Technologies

Technology-level responses are concerned with assessing, and developing tools and techniques for the acquisition, analysis, management, and dissemination of land information. Technology has been the driving force of most activities in land information management. It has created new opportunities, new requirements, and new problems and is therefore often the focus of land information activities. But technology is only one part, and sometimes a very minor part, of a land information system.

### 2.5 Towards the Future

#### 2.5.1 The Role of the Government

Most land information has always been recognized as a public good. Systems and programs, such as the Public Land Survey System, land registries, topographic mapping, and geodetic control are fundamental public services required for the security, stability, and economic well-being of society. Many such programs would not have developed at all without government support and many would not be economically feasible today unless subsidized by the government. Government support plays a major role in assuring the public that such land information programs and systems will be reliable,



generally affordable, consistent, and permanent. Governments need to continue their involvement in providing management of land information.

Governments should also be concerned with land information management because it is in their interest to have the best available information readily accessible for resource management and other activities. As the largest land owners, governments have additional information requirements to manage public lands. Not only will improved information management assist in routine land use decisions, but it may also have unforeseen benefits in responding to crisis situations. Potential litigation may also be prevented, for instance, when information used as the basis for regulatory decisions is questioned.

As the largest producers and users of information, and as the largest custodian of land information systems, governments have the most to gain from such management improvements as providing more efficient access and use of information, or reducing data collection, storage, and maintenance costs. It is in their own interest to maximize the benefits of existing information systems and programs.

Land information management requires research and development, standards, policies, coordination, and leadership. In many senses, these are not private sector interests although the private sector can and should play an important supporting role. The private sector, for example, is often more innovative; new services and products will probably come from private initiatives. But there is a need for an institutional framework within which these innovations can be coordinated and directed to meet user needs more equitably. Government must take the lead role in land information management at the national, state, and local levels.

To coordinate all these activities, the federal government in particular should provide direction and institutional support. The federal government is the source of much of the base information required for systems development; it should also take responsibility to ensure that the necessary infrastructure is in place to use this information to its full potential across the



nation. Emphasis should be placed on facilitating local and state system development, supporting research and development programs, and helping to coordinate these systems and programs. There is a need for a partnership of organizations to develop opportunities, oversee change, and to set a national direction.

#### **2.5.2 Setting the Agenda**

For these land information management concepts to become reality, action is required on several fronts:

a) **User Requirements.**

A process of communication must be initiated between members of the land information community. This process must be ongoing, and not merely a one-time project if participants are to understand the way in which information is used in the decision-making process, and the constraints in the information-flow process.

b) **Policies.**

Among the key issues to be addressed are standards from a land information management perspective, and access to information. To date, work on standards has been fragmented. The model of land information management developed earlier suggests that the various components of standards (e.g., hardware, software, data, and applications) must be integrated in a broad approach. Factors which restrict access to information must be identified and strategies developed to eliminate those restrictions.

c) **Systems.**

Attention must be given to integrating institutional (parcel-based) and natural resource information instead of maintaining them in the traditionally separate and unconnected information systems. Land ownership is inextricably linked to management of the land. Access to information on the rights, restraints, and responsibilities to the land cannot be separated from information about the natural resources if the land is to be used wisely.



d) Technology.

Emphasis must be placed on the identification, development, and use of technology which is appropriate to the requirements of the users.

These issues are reflected in subsequent sections.

Throughout the report, however, twin themes continually appear:

- o The challenge for the 1990's lies not in building databases or developing new information technology per se, but rather in using information more effectively in the wise management of our land and resources; and
- o Effective management of land information can occur only through a partnership of federal, state, and local governments, the private sector, and academia.

### 3. A HISTORICAL PERSPECTIVE OF INITIATIVES

#### 3.1 Introduction

The purpose of the Land Information Management Study is not merely to produce yet another document, but instead to set the stage for action by BLM. The Bureau has the opportunity to embark on a systematic, continuous program of improving the management of land information, the success of which depends on the cooperation and support of other federal agencies, state and local governments, and the private sector. The chances of progress in the future may be greater if we understand the reasons for lack of progress in the past. To this end, we assessed five land information studies which received considerable exposure at the time of their publication. Section 3.2 describes these studies. Despite the substantial research undertaken for these studies and the widespread distribution of their results, real progress has been limited. Section 3.3 identifies some reasons for this lack of progress.

#### 3.2 Analysis of Land Information Studies

Five well-publicized land information studies were assessed. BLM initially selected four studies for review:

- o "Land Title Recordation Practices: A State of the Art Study", prepared for the U.S. Department of Housing and Urban Development in 1978 by Booz, Allen and Hamilton, Inc.
- o "Monitoring Foreign Ownership of U.S. Real Estate", prepared for Congress in 1979 by the U.S. Department of Agriculture.
- o "Effects of the National Environmental Policy Act on Corporate Decisionmaking", prepared for the Office of Environmental Affairs, U.S. Department of Commerce in 1978 by Jack McCormick and Associates, Inc.
- o "Need for a Multipurpose Cadastre", prepared in 1980 by the Panel on a Multipurpose Cadastre, Committee on Geodesy, Assembly of Mathematical and Physical Sciences, National Research Council.



Because of its important relationship to this Land Information Management Study, BSC has also reviewed an additional study:

- o "Procedures and Standards for a Multipurpose Cadastre", prepared in 1983 by the Panel on a Multipurpose Cadastre, Committee on Geodesy, Commission on Physical Sciences, Mathematics, and Resources, National Research Council.

These land information studies were rooted in widely disparate concerns. One addressed foreign ownership, another focused on environmental issues, and three studied local land records. Despite this variety in origin, all suggested the same underlying concept -- improved land management based on a network of land information systems. Through such a network, the report on "Monitoring Foreign Ownership of U.S. Real Estate" maintained, information on land ownership could flow up from the local level and be aggregated into relevant statistics at the state and federal level, e.g., the percentage of rural or urban land owned by foreigners. The report on "Effects of the National Environmental Policy Act on Corporate Decisionmaking" considered the network would allow information collected at the local level to be easily used in Environmental Impact Statements conducted by federal agencies. And by means of the network, the other studies maintained, land information could serve the interests of all levels of government and the private sector.

### 3.3 Impact of the Studies

The wide distribution of the reports provided an opportunity for many of those involved with the management of land information to familiarize themselves with fundamental concepts. While the educational benefits cannot be under-estimated, the studies have not yet contributed to the emergence of a comprehensive, consistent network of land information systems allowing information to be easily transferred from one level of government to another. Some reasons for the lack of progress follow:



### 3.3.1 Lack of Leadership

The studies by the National Research Council identified that without federal leadership, developments would be slow, disjointed, and of uneven quality. The federal government has provided leadership in the development of digital cartographic standards, and, to a limited extent, some federal agencies have participated in the development of land information systems at the local level of government. However, little progress has been made because the federal government did not respond to these studies and use its expertise to work with others in developing policies, procedures, and standards for improving the management of land information.

### 3.3.2 Lack of Authority

Embodied within the studies were a wide range of recommendations. These recommendations were seldom put into practice, not because they were without merit, but because those recommending action lacked the authority to implement the improvements suggested. Because leadership roles have not been accepted and acted upon, responsibilities for systematically improving the management of land information throughout the nation have not been clearly designated or agreed to.

### 3.3.3 Lack of Broad-based Commitment

The driving force behind the creation of a land information network was, in some cases, a single concern. The study on "Monitoring Foreign Ownership of U.S. Real Estate" justified the network as a vehicle for providing the federal government with statistics on foreign ownership of land. The study on the "Effects of the National Environmental Policy Act on Corporate Decisionmaking" envisaged the network as a means of providing federal agencies with environmental information collected at the local level. Even the National Research Council (1983) felt that the requirement of updating assessed property values might cause the courts to mandate the modernization of land information systems, although according to the report, "an annual updating of property characteristics hardly seems enough to justify investing in a multipurpose cadastre".



The design of systems must address the multiple use of land information if resources and efforts are not to be wasted in developing unnecessarily redundant databases.

#### **3.3.4 Lack of Sustained Commitment**

Although all studies were driven by issues which achieved national prominence, the momentum behind some issues was not sustained. The need to address the issue of foreign acquisition of agricultural land has appeared periodically throughout the nation's history, only for the interest to wane. Another example is the Great Blizzard of 1978 along the New England coast which was cited in the 1980 study on the "Need for a Multipurpose Cadastre" as an example of the urgent need for vital land information such as the location of utilities. Once the blizzard was over, however, the need was not so urgent. These and other justifications for developing land information systems received considerable publicity for a time, but interest was not sustained. The timespan from conception of a land information system to its maturity is measured not in months but in years, if not decades. The driving force behind the creation of a land information system must have a similar longevity.

#### **3.3.5 Lack of an Appropriate Skill-mix**

The lack of personnel with a skill-mix appropriate to managing the technical and administrative aspects of land information systems has hampered the improvement of land information. Creating the Centers of Excellence, designated by the Institute for Land Information, and the National Center for Geographic Information and Analysis, sponsored by the National Science Foundation, is an important step towards addressing the problem. However, the Centers presently designated are unable to graduate a sufficient number of students to fill the void. Resources of additional universities must be brought into play. Also of vital importance is the need to upgrade the skills of those already in the service of the federal, state, and local levels of government, and the private sector.



### 3.3.6 Lack of Funding

Advocates of land information systems have stressed that such systems are especially needed in times of financial hardship, since they can be used to ensure that scarce resources are efficiently and effectively utilized. In times of budgetary restrictions, however, new programs are often not implemented. And when a program such as a land information system has high front-end costs and delayed benefits, the chances of it being implemented are not favorable. Furthermore, because the mandates of many agencies tend to cause them to focus on single-purpose programs or projects, funding for multiple-purpose land information systems is often difficult to obtain.

Cost is often the primary obstacle of developing a system, particularly at the local level of government. Without adequate funding strategies for acquiring human, technical, and data resources, development will be sporadic. Traditionally, systematic and coordinated developments, such as the construction of canals, railroads, highways, and airports, and the protection of civil rights and the environment have occurred throughout the country only when the federal government has decided to act and has set up federal programs. Without federal grants, states are faced with a prospect of increasing taxes to support land information management programs and the possibility of driving investments to other states without such taxes.

### 3.3.7 Lack of an Institutional Framework

In general, the origins of successful land information system initiatives can be traced to the actions of a few highly motivated individuals. Frequently, a system may have had only one champion. Problems have arisen when the lead individual has, for one reason or another, relinquished control. For a system to be a permanent feature, it must be independent of any individual. The long-term investments must also be protected by switching the emphasis from the system technology to the institutional framework within which the system is to function.

Most studies failed to address adequately the institutional arrangements required. The National Research Council (1980) did recognize organizational and



institutional requirements as the primary obstacles for the development of land information systems and proposed state and local government Offices of Land Information as a mechanism. Such offices ultimately may prove successful. However, government structures tend to change in an evolutionary fashion, and creating new agencies is particularly difficult in times of financial constraints. An alternative mechanism to formal Offices of Land Information may be required in the short-term if progress is to be achieved. As noted by the National Research Council (1980), components of land information systems already exist within the present government structures. A concerted effort must be made to develop a spirit of cooperation and understanding between agencies responsible for these various components.

#### 4. TOWARDS A COLLABORATIVE APPROACH

##### 4.1 Introduction

Encompassed within any new appreciation of land information management must be a view that our future challenge lies not with developing larger databases or new technology, but with using our land information resources more effectively in the wise management of our land and its resources. Section 4.2 describes some present requirements of land information users. Section 3 discusses responses to these requirements. We believe that to address these requirements adequately, a partnership of federal, state, and local governments, the private sector, and academia is needed. Section 4.4 describes this partnership. Section 4.5 presents a call to action to meet the needs of users.

##### 4.2 Present Requirements of Land Information Users

We interviewed representatives of federal, state, and local governments, the private sector, and academia to assess the needs of users of land information. Due to project constraints, limitations were placed on the number of interviews. The perceptions presented here are, nonetheless, drawn from a broad cross-section of participants, as well as being based on our collective experience. The requirements identified are presented in the following sections.

###### 4.2.1 Need for Direction

Many state and local government agencies are looking for guidance in planning their land information management programs. Where possible, the lower tiers of government often wish to be compatible with the activities of federal agencies, since the federal government is the largest single producer of land information and the largest custodian of land information systems.

###### 4.2.2 Need for Knowledge

As agencies implement land information systems, there is a growing awareness that the information needs of users are not well understood. The requirements for the various decision-making processes must be clearly identified if resources are not to be wasted by



collecting and processing unnecessary or inadequate information.

In many jurisdictions, those assigned the responsibility for establishing a land information system have limited experience with land information or computers.

Information about concepts, applications, and technology is eagerly sought from sources such as the present series of regional and national conferences on land and geographic information systems. While these conferences are of great value, they do not provide an ideal mechanism for educating those with little or no knowledge of land information management.

Beyond that fundamental knowledge, people need to know what their peers are doing. For instance, it is critical to know what information has already been collected, by whom, and how it can be accessed.

#### **4.2.3 Need for Coordination**

There is an increasing awareness that the wise and efficient use of the nation's resources is dependent on the interaction of many federal, state, and local agencies. The need to coordinate activities and to learn from others is also driven by the similar environmental, economic, political, and administrative problems experienced by agencies at all levels of government as they strive to manage the land and resources for which they are responsible.

#### **4.2.4 Need for Access to Information**

At times, access to information is restricted because the collecting agency has not established procedures to release the information for use by others. This resistance may result because the agency regards its information as proprietary. Frequently, access may inadvertently be limited; e.g., an agency may not have the financial or human resources necessary to change indexing or referencing systems and formats to meet the needs of others.

#### 4.2.5 Need to Share Information

The creation of databases requires substantial labor, time, and financial resources. There is widespread agreement that the costs of creating databases must be offset by minimizing the duplication of data collection. Much of the duplication at present arises because data sets collected by one group of users do not meet the area and thematic coverage, accuracy, and format requirements of other users. The need to share information also extends beyond the initial task of creating the database. Agencies which have interrelated operational, management, and policy concerns need to share common information resources if their decisions are to be consistent.

At present, it is difficult for federal and state agencies to obtain uniform information from local governments since substantial variations exist in local level information systems across the country. There has been little incentive for local governments to spend funds on standardizing land information management procedures if the only beneficiaries are state and federal agencies.

#### 4.2.6. Need for Funding

Cost is often the primary obstacle to developing a land information system, particularly at the local level of government. Development has been sporadic when funding strategies for acquiring human, technical, and data resources have not been adequate. Inconsistencies in funding have often resulted in lost investments because the data have not been maintained.



#### 4.3 Required Responses

If the United States, or any country for that matter, is going to promote the effective management of land information, it will have to shift:

- o From the short-term project approach favored by governments, to longer-term, continuous programs;
- o From single-purpose land management goals that meet the requirements of an individual agency, to multi-purpose goals which respond to the needs of the various levels of government and the private sector;
- o From independent activities of agencies responding to their mandates, to active collaboration by many agencies;
- o From funding processes that meet the needs of single objectives, to funding approaches better suited to multi-purpose, multi-agency programs; and
- o From narrow constituencies of support, to one which is broad-based and non-partisan.

In particular, we describe responses in terms of the needs identified in Section 4.2.

##### **4.3.1 Provide Leadership**

Leadership must be provided to develop priorities, assign responsibilities and resources, set standards, and monitor activities. Direction must be given by establishing national policies.

In developing land information management policies, attention should be paid to identifying responsibilities of the federal government for supporting state and local governments through public programs. States, in turn, should be encouraged to designate an entity for establishing standards and procedures for the collection, storage, retrieval, use, and dissemination of land information.

##### **4.3.2 Expand the Base of Knowledge**

###### **a) User Requirements.**

In Section 4.2, we identified some broad requirements of users. However, we need a better, more detailed understanding, since the effectiveness of a land information management strategy depends on how well it meets information requirements.



To date, most concern in the area of determining user requirements has been for so-called "user need studies" often based on interviews or on questionnaires distributed to potential users. One problem with this approach is that many potential users and uses of the information are often not identified. Such studies tend to focus on existing products, users, and uses. The results also tend to be biased by the type of questions asked and the researcher's background. For example, the question "what do you need from a LIS?" implies that a land information system is needed and that the user understands its potential capabilities.

A much broader approach is based on an in-depth knowledge of the functions and mandates that land information and land information systems serve. Neither dependent on specific users nor current products or arrangements, this approach can yield a better understanding of system requirements and constraints. It also allows more room for designing innovative responses to requirements. To be as objective as possible, the requirements should be evaluated by a multi-disciplinary team. The major difficulty in this second approach is that it is time-intensive.

Determining requirements should go beyond the need for specific information products. Technical, institutional, and organizational requirements should also be identified. Technical requirements may be addressed in a relatively short period, for example, by rapid prototyping, whereas addressing institutional requirements may be regarded as an on-going task. Such studies should not unnecessarily delay programs or system implementation. Rather than investing one or two years determining requirements before any action is taken, organizations may be wiser to make provisions to monitor and accommodate evolving needs, constraints, and opportunities during design and implementation.



b) Education.

Traditionally, developers and users of land information systems have often been forced to teach themselves the basics of managing land information. This has usually resulted in a one-dimensional perspective on the problems. Processes suitable for educating members of all branches of the land information community should be developed. Education on concepts and technologies must cater to the special requirements of land information users from policy-makers to field operatives. These processes should foster common perspectives and a common language among users and provide them with the opportunity to upgrade their skills and knowledge.

c) Communication.

Communication is necessary in order to enhance the efficiency and effectiveness of a land information strategy. Maintaining communication is a major challenge within any land information system, and the problems escalate in a network environment. The problems need to be addressed at both the organizational and technological levels.

At the organizational level, users, source agencies, and groups that either support or are affected by the program need to understand what is happening, what their role is or will be, and what problems and benefits to expect. Without this knowledge, there will be little voluntary cooperation or coordination, and initial support may die. Opening up organizational communication lines also allows for continued input and feedback for the program. In multi-organizational schemes, communications become even more important, and there may be a need for special interest groups or committees, workshops, seminars, and educational sessions.

One possibility is an annual public symposium at which federal agencies can present progress achieved and their short- and long-term plans. Such communication would enable state and local governments, and the private sector to obtain information which can be used in developing their own plans. Other meetings can focus on specific needs. For instance, symposia



illustrating methods of incorporating land information maintained by federal agencies into land information systems of local governments should be well received by local jurisdictions.

At the technical level, data exchange is a crucial issue. The problems include whether systems are compatible and what types of data conversion mechanisms are necessary. The issue extends beyond hardware and software considerations. If information contained in various systems is incompatible, then exchange may be severely limited. For example, different map projects or reference datums may be used in graphical databases. Although transformations may be made from one projection or datum to another, the cost of data conversion for each query may prevent data sharing. Such problems need to be addressed at the policy level through, for example, the establishment of common standards.

d) Research and Development.

A systematic and long-term program of applied research and development should be instituted. To date, the research and development agenda has been set primarily by independently competing hardware and software vendors and has been articulated primarily in terms of technical issues. There is a pressing need for an agenda that goes beyond the technical issues of geographic information system (GIS) software/hardware development and database building. It is generally acknowledged by LIS users that the primary impediments to effective application of GIS technologies involve institutional, managerial, economic, legal, and other social issues in addition to the technical issues.

A potential mechanism for setting the research agenda is a workshop similar to the 1985 National Science Foundation Workshop on "Fundamental Research Needs in Surveying, Mapping, and Land Information Systems". Such a workshop could investigate the organizational frameworks and relationships best suited to accomplish the primary goals of end users. It could draw together a broad-based coalition of federal, state, and local government users for the purpose of establishing the functional capabilities of systems



that will meet the integration and multiple-use needs of all users. It would be a focus through which the user community could also articulate the applied research and development needed over the next several years, and thereby direct more effectively the activities in the academic and private vendor communities.

#### 4.3.3 Establish a Formal Management Structure

To coordinate land information management activities, the federal government must provide institutional support at the national level, as well as to other levels. The federal government is the source of much of the base information required for systems development. As such, it should take responsibility to ensure that the necessary infrastructure is in place so the information can be used to its full potential across the nation. Emphasis should be placed on facilitating local and state system development, supporting research and development programs, and helping to coordinate these systems and programs.

Land information management is a continuous process. Two issues relating to this on-going aspect are:

##### a) Creation of Programs.

When funding is limited and when problems are urgent, there is a tendency to invest in "projects" rather than "programs". Projects are limited in size and scope and usually provide short-term, concrete results. Benefits of programs, with much broader goals and larger associated costs, are often more difficult to quantify and generally take longer to achieve. In many cases, programs involve many organizations, whereas projects can be undertaken with little outside cooperation or interference.

Unless there is an overall coordinating strategy in land information management, however, projects can be a very expensive investment in the long run. Land information systems built for specific projects, usually only address the needs of one user group. Such systems often lack provisions for maintaining or upgrading the data to meet more general needs. Typically other users will be unaware of the project,



or the existing systems may be deemed inappropriate for their applications. The result is duplication of effort and resources as these users create yet another database on a project basis. Only in the last few years has the tremendous cost of trying to maintain and improve these partial, redundant databases been realized. To avoid these downstream costs, a continuous, comprehensive program should provide guidance on standards, integration, and continuity even if the information can only be collected on a project basis.

b) Creation of a Permanent Home.

Land information activities are often coordinated by groups such as state Geographic Information System User Groups, State Mapping Advisory Committees, and land records reform movements. At times, such groups have made substantial progress. In many cases, however, efforts are restricted because mandates often require a focus on a narrow range of interests, and only provide for service in an advisory capacity. Furthermore, members of these groups are usually selected because of their positions in government, academia, or the private sector, and the time that they can devote to the groups is often limited by the demands of their full-time positions. More formal structures, such as the Offices of Land Information Systems suggested by the National Research Council (1980; 1983), have not been created within state and local government, in part, due to budget constraints, lack of political acceptability, and the limited number of suitably qualified land information managers to serve in such Offices.

We are encouraged that the need to address a broad range of concerns is being recognized. For example, the Geographic Information Council in New Mexico and the State Map Advisory Committee in Oregon include functions typically assigned to separate GIS user groups, State Mapping Advisory Committees, and land records groups. More attention, however, must be focused on developing institutional structures which can provide the necessary coordination and continuity of land information management programs.



#### 4.3.4 Promote the Concept of Custodianship of Information

Traditionally, information "belonged to" whomever collected or stored it. Thus, similar if not identical information could be owned by several persons or groups. When, in an effort to reduce duplication or to rationalize resources these groups are asked to change customary practices, they often resist, because change is seen as an infringement on their "rights" as "owners" of the information.

These "ownership" distinctions disappear if each group views its role as being responsible for holding the land information in trust for the citizens, i.e., those for whose benefit the information is ultimately collected, and who, as tax-payers, ultimately pay for it. One group may be assigned responsibility for collecting and maintaining a particular set of information to ensure its integrity. Or, for example, the custodian may be asked to collect an additional data item to outside specifications in order to meet other needs. Such a model facilitates the coordination and cooperation required for sharing information, but it must be addressed at the policy level. In turn, the policy must ensure that custodians will have sufficient, continued support to maintain their responsibilities.

#### 4.3.5 Develop Standards and Models

The efficient exchange and sharing of land information depends directly on the use of common standards. Whether an organization is accepting information from an outside contractor, passing information to an associated agency, or distributing information to outside customers, it must face the problem of standards. Some of the issues to be considered are:

- o What is a standard?
- o What should be standardized?
- o Who should set the standards?
- o How can standards be enforced and what incentives can be given to encourage compliance?
- o Who should pay for the costs?

Some attention is being directed towards the provision of standards for items such as:

- o Terminology and definitions;
- o Database documentation;



- o Spatial referencing systems;
- o Linkage and indexing mechanisms (e.g., parcel identifiers and geocodes);
- o Classification and interpretation schemes (e.g., for land use);
- o Cartographic representation (e.g., symbology);
- o Communication and interchange formats;
- o Attributes of data (e.g., accuracy, reliability, and content); and
- o Technology interfaces.

Standards in these areas, at times, have been voluntarily embraced throughout the nation. For example, the Federal Geodetic Control Committee's standards on geodetic control, and the National Map Accuracy Standards have filled a vacuum at the state and local levels of government. There is also widespread interest in new standards being developed, such as the Standard for Digital Cartographic Data proposed by the Federal Interagency Coordinating Committee on Digital Cartography (FICCDC). The U.S. Office of Management and Budget has recently renewed the FICCDC Charter for two more years, with the U.S. Geological Survey remaining the lead agency, and with an expanded role to establish spatial data standards.

To date, however, work on standards has been fragmented. The model of land information management presented in Section 2 suggests the various components of standards (e.g., hardware, software, data, and applications) must be integrated in a broad approach (Figure 4). From this perspective, standards are viewed as a continuum, from conduit to content. These standards must be designed to allow and promote innovation and development, and not to hinder such progress. Long-term, comprehensive standards may not be possible in all instances, nor are they necessarily desirable, because of rapid changes in technology. However, standards such as those for interfacing between systems will promote advancement.

The standards developed should be integrated in a parcel-based land information system model that can be applied to publicly and privately owned land. Three types of models are required:



HARDWARE	SOFTWARE	DATA	APPLICATION
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CONDUIT  CONTENT

Figure 4: Continuum of Standards

- o A multiple-use land management planning model for use by federal, state, and local government agencies, and the private sector;
- o A land information system model that supports decision-making concerning multiple-use of the land; and
- o Model legislation which reinforces land information systems and practices, and which could be used by state and local governments. Model laws offer states the opportunity to draw on the experience and expertise of others. At the same time, individual states are free to modify the model laws to suit their individual requirements. Typically, model laws have been developed by drafting committees comprising those knowledgeable about the field being addressed as well as representatives of the legal community. States have been receptive to model laws, such as those dealing with real estate and marital laws, particularly if those model laws have been endorsed by the National Conference of Commissioners on Uniform State Laws. Since the governor of each state appoints representatives to the National Conference, the states have an interest in this body.

#### 4.3.6 Develop Cost Identification and Recovery Strategies

##### a) Evaluating Costs and Benefits.

Costs and benefits play a major role in program decisions. Benefit-cost analysis has been the major means of justifying new systems or improvements to existing ones. In land information management, however, neither the costs nor benefits are well understood. There is a need for research on costs and benefits relating to both the implementation and the maintenance of land information systems. Of concern is not only the issue of identifying what the benefits are, but also who will receive them and when. Potential benefits are often indirect and difficult to quantify. They may not be realized for years or even generations and are thus heavily discounted, except when institutional arrangements are affected.



b) Recovering Costs.

The costs of implementing computer-based land information systems have focused attention on how costs associated with collecting, processing, and distributing digital information should be recovered. The main concern is with establishing a price for the information or product, but there are many related issues.

Traditionally, most public goods have been provided at a token price. Government maps and surveys, for example, have been marketed at a price well below their true cost of production. As cost recovery becomes more important within government and large investments are made in computerized information, pricing has become a concern. Strategies for setting prices should cover production and handling costs, user demand and willingness to pay, and competition with other producers. Some of the issues that might be considered include:

- o Who should pay for the products and how much, and should different categories of users pay different fees?
- o How should the benefits be distributed?
- o Should front-end costs, such as investments in technologies or the initial conversion of data be recovered through product fees?

Federal and state governments can assist counties and municipalities with the high initial development costs by participating in cost-sharing programs for developing land information systems at the local level. This investment may reduce or eliminate expenses incurred by state and federal agencies in reformatting data for their use: these agencies can ensure that they receive data collected at the local level in the desired formats.



#### 4.4 A Partnership of Government, Private Sector, and Academia

We believe that, to address the requirements of land information users adequately, a partnership of federal, state, and local governments, the private sector, and academia is needed. Such a broad-based partnership could manage the implementation of multiple-use land information management through the creation and maintenance of an integrated network of land information management. Together, these players must develop the "big picture" or conceptual models, as well as the details necessary to implement preliminary programs which integrate natural resource information with land records. Each partner can and should make a vital contribution, but in turn, each needs to draw on the support and actions of others.

Local governments have been widely considered the primary access points for large-scale accurate information, since they are the mandated caretakers for much land information. Despite this, development of multi-purpose land information systems at the local level has been infrequent, partly because single-year budget cycles and periodic political upheaval have often restricted local governments from adopting longer-term perspectives. An increasing number of local governments, however, have recognized the need for a long-term land information management program, and are looking to the federal and state governments, and the private sector for support and guidance.

States bring another perspective to the partnership. Each state has the independent authority to regulate land records and legal activities involving land tenure through legislation, and each state has legislative and administrative ties to its local governments. States are also in a position to provide local governments with incentives and assistance while ensuring compatibility and usefulness of the information for state purposes.

Federal initiatives in support of more comprehensive modernization efforts at the local level may be focused initially on better aggregate data or better access for information required for federal purposes. Two federal roles can be identified: first, as an information provider/analyzer/user, and secondly, as a model and a



resource for local and state programs requiring technical expertise on issues such as control and standards.

The private sector, and the university community can, and should, play important supporting roles in areas such as research and development, collection and processing of the information, and consulting services. These sectors are often more innovative, and new services, products, and concepts will probably come from their initiatives.

#### 4.5 Call to Action

##### 4.5.1 Federal Leadership

We strongly believe that if such a partnership is to be formed and successfully maintained, it will depend upon the constant leadership afforded by a cooperation among federal agencies charged with managing the land. These agencies must begin an on-going collaborative effort to draw together local and state governments, as well as the private sector and academia into a working partnership. The federal government must provide an institutional framework within which actions can be coordinated and directed to meet the needs of society more equitably. For this partnership to be successful, the federal government must have a clear understanding of the roles and responsibilities of its future partners, and in particular, local and state governments, since these are not homogeneous in nature.

The interaction and collaboration of federal agencies is critical. Many federal government agencies have embarked on land and geographic information system initiatives in response to mounting pressures. The present and future land information management requirements of the United States are of such immense proportions and varied natures that these agencies need not be in competition with one other. Instead, the actions of federal agencies can and must be complementary.

Federal agencies are rising to the challenge. An example of this new era of collaboration is the 1988 Memorandum of Understanding which provides the basis for cooperative efforts in surveying, mapping, geodesy, and land information system development between the Bureau of Land Management and the National Oceanic and Atmospheric



Administration. In particular, the organizations seek to build the human and institutional resources necessary for the development and implementation of land information systems, recognizing that this is a long-term, complex process requiring significant investments. The Memorandum reinforces as well the significant role of local governments: "The United States has a vital interest in the skills, motivation, and requirements of local governments, and in the characteristics of their needs, for it is these factors that ultimately determine the nature of local land tenure policies".

Another collaborative effort of significance is the Memorandum of Understanding establishing the Northwest Land Information System Network, a partnership currently of nineteen federal and state agencies in Oregon and Washington. This network was initially promoted by the BLM Oregon State Office as a vehicle to share digital data between resource management agencies. The Charter of the Network specifies a long-term program direction which encourages the sharing of data and system resources, and calls for an assessment of the feasibility of an integrated regional database.

#### 4.5.2 Scenarios

A key ingredient to improving the management of land information is the development of land information systems which allow the integration of parcel (or institutional) information with natural resource (or environmental) information. A key element in the establishment and maintenance of comprehensive land information systems is local governments, since they are the focal point of much land information activity and the source of much detailed, parcel-based land information. The "bottom-up" approach calls for large-scale, accurate land information collected by local governments to flow upwards through a network, as required, to the state and federal levels of government. This network of land information systems would also enable information contained in federal databases to flow down to state and local governments.

These actions should be developed and refined in an environment which allows the integration of natural resource information and land records within the "bottom-up" approach. Long-term programs should be



initiated by the federal government to demonstrate how local governments and other users can easily obtain access to federal land information through the network. Instead of pilot projects, these proving grounds should be considered preliminary programs which will be expanded into full-fledged multi-user, multi-purpose programs over time. The standards and models should be tested in preliminary programs in a number of geographically and culturally different jurisdictions in order to identify issues common to users across the nation.

These programs must be based on demonstrated land management needs and should involve local governments which have already demonstrated a commitment to improving the management of land information by investing their own resources and should build on the results of programs such as the Resource Management Plans developed by BLM. The programs should illustrate how local governments can obtain federal land information regardless of their hardware and software. To this end, the local governments should be selected so that they represent a cross-section of users of the most popular commercial GIS technologies. A research team, possibly from an academic community or the private sector, should develop generic interfaces between the federal land information sources and these leading commercial GIS technologies.

The programs should be well advertised throughout the nation. Participants should formally report on the technical and institutional considerations for integrating federal, state, and local land information. In this manner, other jurisdictions may use the knowledge gained to implement their own systems.



## 5. THE BUREAU OF LAND MANAGEMENT: RESPONSIBILITIES AND RESPONSES

### 5.1 Introduction

It has become clear in course of this Land Information Management Study that several models are needed if land information management is to be improved. First, there is a need for a model which describes land information management in terms of policy-, systems-, and technology-related responses to the requirements for land information. Another model required is that of interaction between the various participants. There is also a need for a model which describes a land information system in terms of the requirements for land information management and interaction between groups. We described the land information management model in Section 2. In this section, we turn our attention to the other two models.

Section 5.2 describes BLM's mission. Section 5.3 describes the model of the Land Information System (LIS) being developed by BLM in response to these mission requirements, and Section 5.4 discusses the potential participation of other agencies and organizations in developing this LIS. A land information system, no matter how good it may be technically, will fail if it is placed in an inadequate operating structure. Therefore, in Section 5.5 we describe the model used by BLM to encourage effective participation by others. Section 5.6 discusses how other agencies may use BLM's LIS in the future in terms of some existing land information needs. Section 5.7 describes a potential role of BLM in improving land information management.

### 5.2 The Bureau of Land Management's Mission

BLM's activities are extensive, not only in terms of the land area being managed, but also with respect to the diverse and often conflicting demands regarding the use of the land. BLM has direct responsibilities in about one-quarter of the United States; the agency manages approximately 275 million surface acres and another 300 million acres of mineral rights. BLM's sphere of influence is considerable throughout the country. The agency is responsible for cadastral surveys on all federally owned land (about one third of the nation).



Furthermore, the Public Land Survey System (PLSS) which was created in 1785 is recognized as the framework for the establishment of land information systems (LIS) by many counties in the western and midwestern states.

BLM is directed by the Federal Land Management and Policy Act (PL 94-579) which specifies that the public lands be managed in a manner which:

- o Recognizes the nation's need for domestic sources of minerals, food, timber, and fiber from the public lands;
- o Protects the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water, and archeological resources;
- o Preserves and protects certain public lands in their natural conditions where appropriate; and
- o Employs as a basis, the principles of multiple use and sustained yield unless otherwise specified by law.

Furthermore, to the extent consistent with the laws governing the administration of the public lands, BLM is required to coordinate the land use inventory, planning, and management activities relating to these lands with comparable programs of other federal agencies, and with those of the state and local governments within which the lands are located.

This concept of stewardship has been recently underscored by the Bureau of Land Management (1989) in its Master Plan:

Man is linked to and dependent upon the land and its resources and even though we are moving into a high-technology 21st century, our life support system remains the same as always -- planet earth. As steward for the multiple use lands of the United States, BLM's mission is to manage these lands in a manner that makes use of its productivity and capability of sustaining a wide variety of uses to meet the environmental, economic, and social needs of the American people. BLM supports and encourages a land ethic of wise use and conservation of our lands and its resources for current generations and a passing on of those lands to future generations in an improved condition. We want to make the country and its land better for our efforts. Management of the information assets about land is critical to making decisions about how to



best use our natural bounty and still preserve future capabilities. Our vision is to have available for managers, specialists, and the public, land information in an organized, automated system based upon legal land parcels that allows BLM and other users to access and use data in support of a sound multiple-use land ethic.

### 5.3 BLM's Land Information System Model

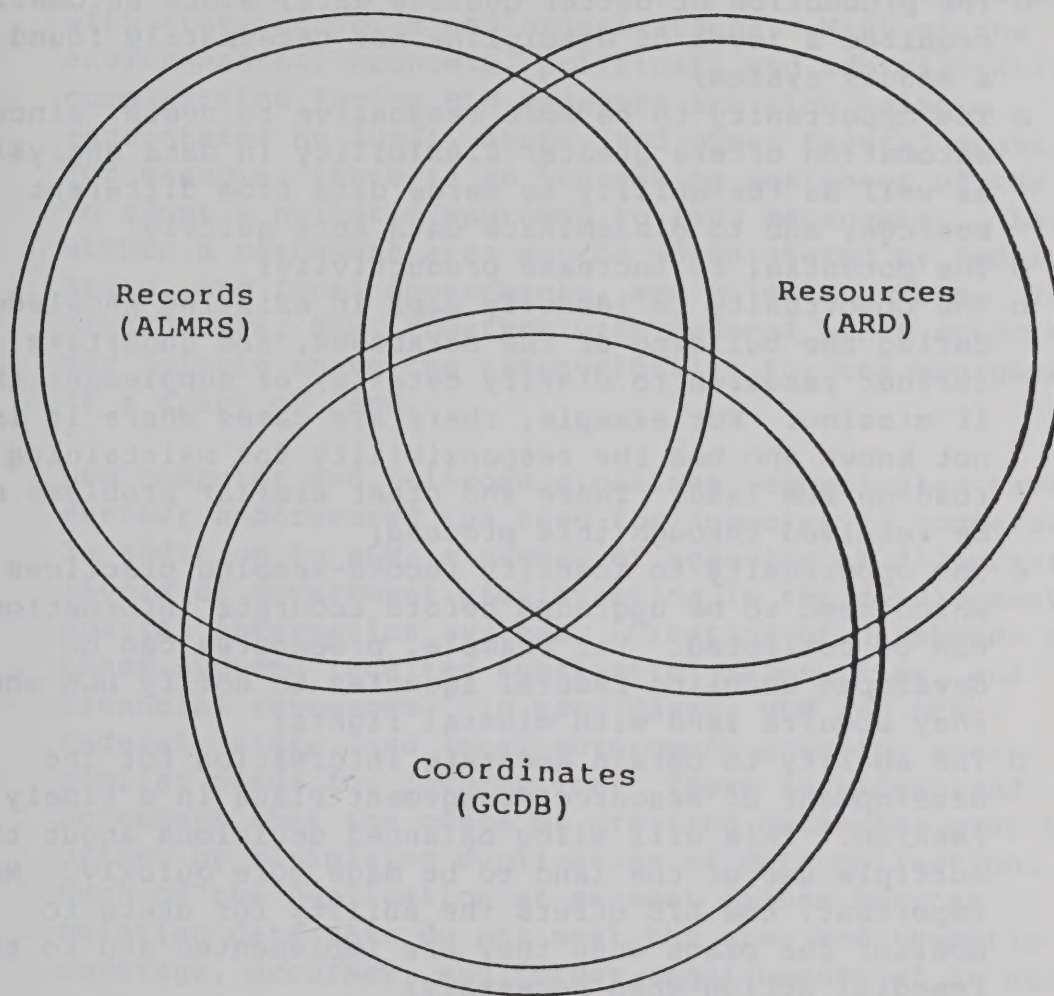
BLM has identified that land information must be managed effectively if it is to manage public lands and resources for multiple use. To achieve this goal, BLM is developing a pioneering automated Land Information System (LIS) which will draw together land records and natural resource information for the first time. Development and implementation of the LIS is guided by the principles that:

- o BLM manages information, as well as lands and resources, as valuable public assets;
- o BLM shares information with others in support of agency missions; and
- o Computer-based tools can help BLM personnel be more responsive to the needs of society.

The LIS comprises three elements (Figure 5):

- o The Geographic Coordinate Database (GCDB) system which contains coordinates of Public Land Survey System corners as well as non-rectangular corners. The GCDB provides the ability to link and register land records and natural and cultural resource data to legal descriptions of land parcels;
- o The Automated Land and Mineral Record System (ALMRS) which provides information about legal land descriptions, ownership status, special designations (e.g., land withdrawals), and use authorizations (such as mineral leases, mining claims, and road and pipeline rights-of-way); and
- o The Automated Resource Data (ARD) system which manages information about the natural and cultural resources and characteristics of land administered by BLM.





**Figure 5: Components of BLM's Land Information System:**  
o Automated Land and Mineral Records System (ALMRS)  
o Automated Resource Data (ARD)  
o Geographic Coordinate Database (GCDB)

We interviewed a cross-section of BLM personnel who identified potential benefits of the Land Information System. These benefits include:

- o The production of better quality data, since automation requires a level of discipline not necessarily found in a manual system;
- o The opportunity to be more responsive to needs, since automation offers greater flexibility in data analysis, as well as the ability to merge data from different sources, and to disseminate data more quickly;
- o The potential to increase productivity;
- o The opportunity to identify gaps in existing knowledge during the building of the databases, and undertake further research to clarify details, or supplement them if missing. For example, there are cases where it is not known who has the responsibility for maintaining a road on BLM land. These and other similar problems may be resolved through this process;
- o The opportunity to identify record-keeping practices which need to be upgraded before accurate information can be collected. For example, procedures can be developed enabling federal agencies to notify BLM when they acquire land with mineral rights;
- o The ability to obtain accurate information for the development of Resource Management Plans in a timely fashion. This will allow balanced decisions about the multiple use of the land to be made more quickly. More important, the LIS offers the ability for users to monitor the plans when they are implemented and to take remedial action when necessary;
- o The ability to provide documentation needed for new BLM personnel to become effective more quickly. At present, much information of value is stored in the minds of people working in local offices. When personnel in a BLM office retire or are transferred, that office may lose some of this information; and
- o The opportunity to make better decisions about the allocation of the Bureau's resources, since the LIS offers the potential for information about priorities to flow from the resource areas to Washington, D.C.



#### 5.4 Participation with Others in Developing the LIS

As the BLM has evolved to meet the requirements of its charter, and as priorities have been identified in terms of responsibilities for managing land information, the Bureau has perceived an increasing need to collaborate with other agencies and organizations. Many of the environmental, economic, political, and administrative complexities facing BLM managers are also being encountered by local, state, and other federal agencies. For example, there is an increasing awareness of the need to adopt a holistic approach to land management. Land within a catchment area may be administered by federal, state, and local governments, and private owners. In other cases, BLM, together with several other agencies, may jointly share the responsibility for the management of a tract of land.

New computer and telecommunications technologies have further underscored the need for agencies to cooperate. In addition to BLM, a number of agencies at different levels of government are investing in the development of spatial information systems. Creation of databases for these systems requires substantial labor, time, and financial resources. In many cases, BLM and other federal, state, and local government agencies share similar needs for information. There is widespread agreement that the costs of creating databases must be offset by minimizing duplication of data collection. Much of the duplication at present arises because existing data sets do not meet the area and thematic coverage, accuracy, and format requirements of an agency, or because agencies are unaware that suitable data sets have been collected by others.

Coordination and cooperation extend beyond the task of the initial creation of the databases. The need to share common data sets because of interrelated operational, management, and policy level decision-making concerns will continue to drive the ongoing transfer of information between agencies. For example, while BLM's activities focus on the land in which the federal government has retained an interest, land management practices must be integrated with those of agencies or individuals responsible for the management of abutting land. These practices can include the management of programs relating to watersheds, endangered species,



cultural resources, recreation, grazing, timber, and fire suppression.

The need for collaboration is based on practical realities: fires and spotted owls have no regard for institutional boundaries demarcating federal, state, county, and private land. And beyond the boundaries of the BLM administered public land, the Bureau's responsibility for minerals management of reserved federal minerals underlying lands where the surface is managed by another federal agency or are in private or state ownership creates a necessity for shared data.

Responses of representatives of federal, state, and local governments, the private sector, and academia reinforce the value of the LIS being developed by BLM. The LIS is unusual in that it reflects the land management and cadastral responsibilities of the Bureau: the system contains natural and cultural resource information, land registration information, and cadastral survey information. Within the pilot project areas of New Mexico, Wyoming, and Oregon, keen interest has been shown by a broad spectrum of possible users in using the new land information products. Consequently, it is probable that, as the LIS is implemented elsewhere, the availability of the information will be met with strong demand. BLM offices throughout the nation have established cooperative relationships with many other agencies of all levels of government, the private sector, and academia. Examples presented here are illustrative and not exhaustive.

#### 5.4.1 Other Federal Agencies

BLM serves as custodian of the nation's public lands and federal mineral rights and as cadastral surveyor of federal lands. These roles have necessitated that BLM interact with other federal agencies. As a result, BLM already has in place strong working relationships with agencies whose participation in fostering improved land management is essential.

An increasing number of federal agencies are developing, or have signaled their intention to develop, systems similar to the Bureau's LIS. For these agencies to make mutually consistent decisions, they must use consistent information. For example, it is no longer sufficient for



agencies to agree to the position of common cadastral monuments on the ground; they need also to agree to the abstract representation of these monuments in computer databases. We anticipate that access to more accurate information will go a long way towards resolving land-use conflicts between agencies.

As many administrative and resource management boundaries are proclaimed using the Public Land Survey System (PLSS) designations, access to the Geographic Coordinate Database and the Automated Land and Mineral Records System will aid many federal agencies. At times, access to resource information, (e.g., wetlands, protected waterways, coastal erosion or sea level rise, soils, environmental conditions, etc.) on BLM land is required for the management of programs by other federal agencies. The LIS is seen also as a vehicle for providing current listings of BLM land available for disposal. Land exchange is an important method of acquiring land by agencies entrusted with the protection of natural resources.

#### **5.4.2 State Governments**

BLM and state agencies have the potential of sharing a wide variety of land information. For example, in the western states, agencies which are responsible for state and school trust land, such as the Land Offices and the Western Land Commissioners Association, share similar land registration and cadastral information needs to those of BLM, and have expressed keen interest in the LIS. Existing information transfers between BLM and state agencies underscore the interaction that can occur in the development of the LIS. For example, on-line access to information in wildlife inventories and cultural databases is already provided to BLM in some states, while in other states, the Bureau files water and mineral rights or participates in joint mapping ventures for mineral leasing.

#### **5.4.3 Local Governments**

A number of local governments have already initiated land information management programs. The more progressive governments have incorporated these programs with programs to maintain the Public Land Survey System. These governments may have more accurate land information



in their possession than BLM; methods must be devised to ascertain the accuracy and to transfer required information back and forth when needed. Other jurisdictions can use information contained within the Bureau's LIS as a starting point for developing their own land information systems.

The interaction between the Bureau and local governments extends beyond the initial creation of databases. Cadastral surveys performed by BLM and information regarding changes to rights, responsibilities, and restraints are recorded with local governments. In addition, to the extent consistent with the laws governing the administration of public lands, BLM is required to coordinate the land-use inventory, planning, and management activities relating to these lands with the land-use planning of the local governments within which the lands are located.

#### 5.4.4 Private Sector

The development of the Land Information System is a mammoth undertaking. Collection of information for the Geographic Coordinate Database (GCDB), the Automated Land and Records Management System (ALMRS), and the Automated Resource Data (ARD) components of the LIS throughout the nation will require extensive resources. Where necessary, the data will be collected anew, for example, the cadastral re-surveys performed in the Powder River Basin, Wyoming, or the 1:4,800 mapping compiled from aerial photography for the Western Oregon Digital Database. In other cases, the optimum method of data collection will be re-formatting existing digital data or converting data in conventional media to digital form.

Whatever method is chosen as most suitable for a particular region, the task will be immense. Because much of the intensive activity will be associated with the relatively short-term process of database building, BLM need not invest in the necessary labor or technology. Instead, the collective resources of the private sector must be considered for data collection activities -- whether it be collecting new data from aerial or field surveys, or converting existing data. These activities, nonetheless, must be in accordance with the standards and procedures designed by the Bureau.



The private sector is also in a position to provide BLM with data on an on-going basis, for example, with confidential information on coal resources for planning purposes, and cadastral information obtained through re-surveys of land abutting that administered by the Bureau.

#### 5.4.5 Academia

The Land Information System is a complex system interacting with all aspects of society. It will have a wide range of potential impacts, many of which may not be presently identified. Applied research on managerial, institutional, economic, legal, and technical issues will be required. There is also a vital need for managers and users of land information to be knowledgeable if the information is to be used effectively in decision-making.

The university community is best suited to addressing these research and educational concerns. These activities, however, must be coordinated and directed within an institutional framework to ensure that the needs of users are equitably met. A potential model is the Northwest Universities Network, which is an integral part of the Northwest Land Information Systems Network currently being developed in Oregon and Washington. (The Northwest Network is described in more detail in Section 5.5). The specialized nature of research within universities also provides BLM with otherwise unavailable information, for example, the archeological data made available to the Bureau by the University of New Mexico.



## **5.5 BLM's Model for Participation**

BLM must provide opportunities for local, state, and federal agencies, the private sector and academia to participate in the development and use of the Land Information System. The Bureau can draw on its considerable experience in this regard, for the agency has played crucial roles in drawing agencies together in two major ventures -- the Boise Interagency Fire Center, and the Northwest Land Information Systems Network. This section briefly describes these ventures and then discusses the factors which have contributed to the success of this model for participation.

### **5.5.1 Boise Interagency Fire Center, Idaho**

The Boise Interagency Fire Center was established in 1965 as a cooperative venture of six federal agencies to improve the coordination of fire-support activities among federal and state firefighting agencies. The Center is called upon to help in cases of emergencies when local, state, and regional resources are exhausted. Each federal agency has its own individual funding and mission, but all cooperate in programs to improve the efficiency and economics of support to wildfire suppression efforts nationwide.

The agencies participating in the Center are the Bureau of Land Management, the Bureau of Indian Affairs, the Fish and Wildlife Service, the Forest Service, the National Park Service, and the National Weather Service.

### **5.5.2 Northwest Land Information Systems Network, Oregon/Washington**

The Northwest Land Information Systems Network was established in 1987 through a multi-agency Memorandum of Understanding. The network provides a means for sharing digital resource data among federal, Oregon, and Washington resource management agencies.

The following agencies are currently members of the network:

- o Federal Government: The Bureau of Land Management, the Bureau of Indian Affairs, the Corps of Engineers, the Fish and Wildlife Service, the Forest Service, the Geological Survey, and the Soil Conservation Service;



- o Oregon Government Agencies: The Department of Energy, the Department of Forestry, the Department of Geology and Mineral Industries, the Department of Transportation, and the Department of Water Resource;
- o Washington Government Agencies: The Department of Natural Resources, and Department of Wildlife; and
- o Other Agencies: Bonneville Power Administration, the NW Indian Fisheries Commission, and the NW Power Planning Council.

The charter of the Network specifies a long-term program direction which encourages the sharing of data and system resources, and calls for an assessment of the feasibility of an integrated regional database. A Management Steering Group has been assigned the responsibilities for establishing the constraints, operation parameters, levels of involvements by agencies, and funding strategies, while a Technical Working Group has been created to address technical issues.

### 5.5.3 Review of the Model

The Boise Interagency Fire Center and the Northwest Land Information Systems Network grew out of different concerns and operate in different environments. Despite the differences in the nature of activities, several factors appear common to the success of both ventures. They are:

- a) Recognition of the need for joint participation.
  - o The Fire Center developed from BLM's concern in the mid-1960's that coordination between firefighting agencies had to be improved. There is now a common agreement that fire suppression is an expensive activity and that agencies cannot use their resources completely independently.
  - o The Northwest Network grew out of BLM's concern that duplication of data collection efforts had to be reduced, and that access to scarce skills and technology had to be provided. This concern resulted in part from the agency's experience in developing the Western Oregon Digital Database, which involves large-scale, accurate base, cadastral, and resource mapping of an extensive area of Western Oregon.



b) Creation of a climate for joint participation.

- o Although BLM is the host agency of the Fire Center, major decisions about fire suppression are made by the directors of the participating agencies. This process has been described as "a committee that worked."
- o BLM felt from the start that the Northwest Network would be accepted only if it was the product of the user community. Considerable effort has been devoted to the establishment of a common user group. Because the chairmanship of the Network's Management Steering Committee is co-chaired between BLM and USGS no-one perceives the network to be driven by a single agency. All agencies are encouraged to participate in defining the agenda and to make the development of the network a democratic process.

c) Level of Commitment.

- o The highest level of commitment has been given to the Fire Center. BLM, the Bureau of Indian Affairs, the National Park Service, the Fish and Wildlife Service, and the Forest Service are all Washington Office level fire management staff, and the National Weather Service component is the regional Idaho office.
- o The need for the Northwest Network was first identified by people working at the technical level, but it was recognized that the commitment of the heads of agencies was essential if the venture was to be a success. Consequently, the Network's Management Steering Committee comprises those with the authority to make decisions and to commit their respective agencies to specified activities.

d) Common Base of Interest.

- o Personnel at the Fire Center share a common interest base. The fire suppression community is a small close-knit one which shares a common language and educational background.
- o Within the Northwest Network, a concerted effort was made to identify a base of interest shared by all



agencies and to begin work on developing that base. The Public Land Survey System and hydrography themes were found to be common to almost all agencies.

e) Focused Activities.

- o The Fire Center undertakes a highly focused, intense activity for a comparatively short time. Their mission is to get in, solve the problem, and get out.
- o Within the Northwest Network, projects which were small enough to manage yet significant enough to produce tangible benefits were initiated. These focused activities also serve as practical educational tools.

f) Qualified Personnel.

- o The specialized nature of operations conducted by the Fire Center has attracted staff who are technically competent, highly motivated, and who are able to work together effectively in crises.
- o The Northwest Network has been fortunate to have personnel within federal agencies who can provide both technical and managerial leadership. As is perhaps the case in almost any successful project, suitable personnel has been the most important factor in the success of the network. They have been able to apply the technical lessons learned in projects such as the Western Oregon Digital Database project to the network. Probably more important, however, has been the ability of the network architects to read the local situation and to provide the diplomacy and tact needed to create the climate in which interaction between agencies could occur.

## 5.6 Land Information Needs of Other Agencies

This section describes the potential use of BLM's Land Information System in terms of an existing series of information needs of states and counties. A list of possible needs could be quite extensive and could vary considerably in priority. In the following examples, we present land information needs important enough for states and counties to have already committed their time and dollars to addressing.

### 5.6.1 Counties

An increasing number of local governments are initiating programs to maintain the Public Land Survey System (PLSS). This effort is usually in conjunction with an active automation program. In most cases, the program consists of locating monuments placed during the original PLSS surveys of the General Land Office, and restoring the lost or missing monuments using legal re-survey procedures. The more progressive counties derive State Plane Coordinates for their PLSS monuments by measuring between the monuments and the National Geodetic Reference System monuments, thereby providing an accurate spatial framework for land information systems. These programs generate many useful products such as more accurate tax mapping. Some examples of activities in counties are:

#### a) Kenosha County, Wisconsin.

A project initially focusing on increasing efficiency in zoning decisions is being established in Kenosha County. The project, however, is built upon the concepts of the multi-purpose cadastre proposed by the National Research Council. The project is a joint partnership of the County and the South Eastern Wisconsin Regional Planning Commission (SEWRPC). SEWRPC, a planning district covering seven counties in the most heavily populated area of Wisconsin, has a long tradition of innovation in land information management. Racine County, in cooperation with SEWRPC, was the first in the nation to establish a coordinate framework on Public Land Survey System legal corners to control property and resource mapping.



All section and quarter-section corners in the Kenosha County project area have been recovered, remonumented and tied to the geodetic framework through third order, class I surveys. Topographic maps at a scale of 1:2,400 showing building footprints, pavement edges, contours, and water courses have been produced from 1980 aerial photography. These maps meet National Map Accuracy Standards. A number of themes, including soils, flood hazard areas, existing land use, and zoning are derived from existing sources. A parcel identifier links parcels to a variety of information, including that on ownership and valuation.

The cadastral information is compiled from subdivision plats, certified maps, and survey records. Streets, railroads, major utility rights-of-way, and civil division boundaries are determined from legal descriptions. Cadastral maps are first drafted onto a stable base and then digitized. Parcel identifier numbers are then added.

b) Wyandotte County, Kansas.

Wyandotte County is one of the smallest counties in Kansas but has the second largest population in the state. The County has one of the oldest county land information systems in the country. The land information system developed out of a need to solve chronic tax administration problems. Inaccuracies of maps and land records were highlighted in 1971 when the County re-appraised assessment values and installed a computer billing system. Because of deficiencies in existing records and maps, many parcels were not taxed, whereas others were assessed more than once. Files duplicated information and were generally inconsistent. These and other inadequacies prevented County decision-makers from obtaining accurate information in a timely manner.

The Wyandotte County Base Mapping Program was initiated in 1973 with the long-term goal of creating a multi-purpose, parcel-based land information system. Program staff work closely with the County Clerk, County Appraiser, Registrar of Deeds, County Treasurer, and the Data Processing Department to



coordinate daily operations and systems planning for County functions. The County also cooperates with the City of Kansas City and the Board of Public Utilities.

Accurate, large-scale topographic and cadastral mapping form the base of the program. These maps are designed to meet the common needs of all local government agencies. The entire County is mapped at 1:1200 scale. Parcel boundaries are delineated on the maps using evidence from land records, surveys, plats, and plans. All mapping is now in digital form. Textual files from several autonomous offices are integrated into a database. Each department directly maintains the portion of the database for which it is officially responsible. Unique parcel numbers provide a link between the database and the cadastral mapping. In addition to topography and cadastral parcels, the land information system has information on street networks, sewer networks, and service districts such as voting precincts and utility districts.

#### 5.6.2 States

##### a) Wisconsin.

Wisconsin, in general, has a long tradition of significant research and development in land information management. The State was the first to attempt to identify the cost to the citizen to maintain the land information base (Larsen et al, 1977). More recently, the Wisconsin Land Records Committee was established by executive order in 1985 to address the immediate needs of state and local agencies regarding land records collection and management, and the long-term issues of land records modernization. Recently, Wisconsin's activities in land information management have concentrated in the areas of system development within agencies, primarily in the Department of Transportation (DOT), and cooperative professional activities.

The Wisconsin DOT has a long history of leadership in innovative transportation activities, and has become a leader in applying geographic systems technology to transportation. The DOT system is based on 1:100,000 scale mapping. A number of existing databases of



themes such as the transportation network, pavement management, engineering, accidents locations, and hydrography are integrated into the system.

Much of the professional society activities are focused through the Wisconsin Land Information Association. The Association developed from the efforts and recommendations of the Wisconsin Land Records Committee. The Land Information Association, now a state society of the Urban and Regional Information Systems Association (URISA), still maintains close ties to the Wisconsin Land Records Committee. The Association is gaining increasing recognition as a forum for sharing state-wide applications and concepts to all professions involved with managing land information. For example, the State's Professional Land Surveyors Association recently recommended that all state surveyors join the Wisconsin Land Information Association.

b) North Carolina.

Prompted by joint concerns of local government decision-makers, surveyors, tax assessors, and conveyancers about the condition of land records in local governments, the North Carolina General Assembly established the Land Records Management Program in 1977. This state program, the first in the nation to help local governments modernize their land records systems, has closely followed the recommendations of the National Research Council for a multi-purpose cadastre. Since then, several other states have used North Carolina's model to establish similar programs and have adopted the State's standards and specifications.

Through the Land Records Management Program, the State provides technical and financial assistance, for example, participating counties are eligible to receive state funding for up to 50% of the cost of their land records improvement projects. Although participation by counties is voluntary, the Land Records Management Program has been a driving force in the improvement of land records from its inception. At the start of the program, only 10 of North Carolina's 100 counties had large-scale accurate



mapping. Currently, 38 counties have county-wide map coverage and another 35 counties have initiated comprehensive mapping programs. The Land Records Management Program has also been instrumental in making North Carolina a leader in the use of geographic information systems as decision-making tools in local governments: 22 counties have such capabilities and a further 10 counties expect to purchase geographic information systems within the next 18 months.

Agencies of all levels of government and the private sector demonstrate a willingness to work closely together to coordinate mapping and land records activities, to share resources, and to eliminate duplication of effort. The Land Records Management Program is complemented by a wide range of activities, for example:

- o Federal agencies such as the U.S. Forest Service and the U.S. Soil Conservation Service have cooperative agreements and funding arrangements with local governments to ensure that new mapping products are useful to a wider range of users;
- o A unified approach to mapping and land records management is being fostered by the State as it coordinates activities of the Land Record Management program with those of other state agencies such as the Department of Revenue, the Department of Transportation, and the Department of Cultural Resources;
- o County governments contribute to the creation of a state-wide database by providing the State with digital mapping information produced for local projects; and
- o By providing information to the local governments, public utilities such as railroads and electric companies have been instrumental in the development of large-scale, accurate cadastral maps.



### 5.7 The Potential Role of BLM

Effective management of land information can occur only through a partnership of federal, state, and local governments, the private sector, and academia. This broad partnership can be developed only with leadership by the federal government. A catalyst is needed to stimulate this leadership.

We believe that BLM can act as this catalyst for change by encouraging federal, state, and local agencies to participate in coordinating land information activities. While it is not widely publicized, BLM has already undertaken action of the sort expected by the federal government. The Bureau has developed a land information system model which supports multiple-use land management. This model, we believe, can be used by agencies responsible for land information and land management throughout the nation. BLM has also developed a proven model for participation and interaction by a variety of land information and land management agencies.

BLM is well positioned to make a significant contribution towards improving the management of land information:

- a) As a manager of land, BLM can share its experience and expertise gained from efforts to improve its own information management. Through its mandate to provide for multiple use of the land, BLM has had to weigh its decisions in terms of all potential consequences -- environmental, economic, and institutional. And as a user agency, BLM can contribute its experience in not merely producing information, but in responding to management needs for information.
- b) As a manager of spatial data, BLM can contribute its expertise in maintaining spatial data, for example, in the form of master title plats and other surveying and mapping products, and its experience in integrating this information with textual land records.
- c) As the custodian of foundation information, BLM can contribute its skills in managing the land tenure system. In thirty states, the Public Land Survey System (PLSS) is recognized as a basic framework for any multi-purpose land information system. Not only

did the Bureau, in effect, create and implement the PLSS, but through its current efforts in creating its Land Information System, the agency can demonstrate how the Public Land Survey System can be revitalized. When combined with State Plane Coordinate Systems, the PLSS can provide an ideal geometric framework for the development of land information systems, permitting the accurate integration of parcel-based ownership information with resource information.

- d) As an active partner with other government agencies, BLM can contribute its expertise in responding to joint management issues. BLM has forged both mandated and voluntary working relationships with other federal, state, and local governments.
- e) As an active partner with academia, BLM can contribute its experience in promoting education. BLM's role in developing a surveying/land information systems program at New Mexico State University, and the Bureau's cooperative programs with other universities, are increasing the numbers of land information and land management specialists.

BLM should not only continue to pursue these activities but should broaden its horizon to interact with more groups, and to communicate these activities more widely.



## 6. CONCLUSIONS AND RECOMMENDATIONS

### 6.1 Overview

In this study of Land Information Management, we have underscored an increasing awareness throughout the United States that wise management of land resources is critical to sustaining the economic development and protecting the cultural and natural heritage of our country. Along with this awareness, there is increased recognition that information about the land must serve as the foundation upon which land-related decisions are made, implemented, and enforced. In this regard, we have described the awareness of the need for government agencies and the private sector to share land information so they may make mutually-consistent decisions based on consistent, accurate information. And we have described the frustrations caused by the inability of land information users to gain access to needed information and the resultant growing recognition for a new paradigm of information-sharing through a land information network or confederation of land information systems.

A partnership of federal, state, and local governments, the private sector, and academia is needed to make this paradigm of land information management a reality. This partnership has roles both in creating and maintaining the network. The actions of federal agencies are crucial. This broad partnership will develop only with leadership by the federal government. A catalyst is needed to stimulate this leadership by federal agencies. The Bureau of Land Management has the expertise and charter for serving as this catalyst.

We cover these issues in more detail in the following sections. Section 6.2 summarizes the new awareness of land information management that is emerging. Section 6.3 presents our call for a broad partnership of agencies and organizations. Section 6.4 describes our call for federal action. Section 6.5 gives our call to action for BLM. Section 6.6 presents our epilogue.



## 6.2 Towards a New Understanding of Land Information Management

The land is the foundation of the American culture and economy. Nearly every activity of society impacts the land and depends on the land as its base. As land use becomes more intense and complex, competition for specific tracts of land and for resource use is escalating. Despite the vastness of the land, there is a growing recognition that America's land resources are limited. Management of these resources is critical to sustaining both future economic development and the natural heritage.

The opportunities of tomorrow are being determined by the land-use decisions of today. These decisions must be weighed in terms of the potential environmental, economic, and institutional consequences. For the decision-making process to be efficient and effective, accurate and appropriate information must be available in time and in the form required by the decision-makers. Like the land itself, information must be recognized as a resource that requires explicit management to realize its full potential.

To support the process of effective decision-making, managers and users of land information are beginning to focus their activities on identifying, developing, and implementing appropriate responses to the requirements for land information. At one level, this involves the implementation of information technologies. At a higher level, there is a need for system-related responses which provide the technical, personnel, and organizational support for individual projects and more broad-reaching programs. At another level, efforts should be concerned with the development of policies to guide, regulate, and support systems. Policy-, systems-, and technology-related responses are inter-related parts of an overall land information management strategy.

If the United States, or any country for that matter, is going to promote the effective management of land information, it will have to shift:

- o From the short-term project approach favored by governments, to longer-term, continuous programs;
- o From single-purpose land management goals that meet the requirements of an individual agency, to multi-purpose



- goals which respond to the needs of the various levels of government and the private sector;
- o From independent activities of agencies responding to their mandates, to active collaboration by many agencies;
  - o From funding processes that meet the needs of single objectives, to funding approaches better suited to multi-purpose, multi-agency programs; and
  - o From narrow constituencies of support, to one which is broad-based and non-partisan.

### **6.3 A Call for Partnership**

As we have noted, individual efforts to promote improved land management and LIS activities at the federal, state, or local level often fail because of a lack of scale or sustainable support. Rather, what is called for is a partnership of federal, state, and local governments, the private sector, and academia to transform effective concepts of land information management into effective action. Such a broad-based partnership, we firmly believe, could manage the implementation of multiple-use land information management through creation and maintenance of an integrated network of land information systems.

#### **6.3.1 Action as Creators**

The various players must participate jointly in developing suitable responses to improve land information management. These responses include developing standards and models, initiating educational and communication programs, improving access to information, and coordinating research and development activities. These activities must be led by the federal government in consultation with the other partners.

#### **6.3.2 Action as Participants**

The various levels of government, the private sector, and academia must participate in a network of land information systems containing detailed and accurate information. Such a network will enable land information collected by local governments to be efficiently accessed and to flow upwards to state and federal levels of government, as well as allowing information contained in



federal databases to move down to the lower tiers of government.

Land information management activities must be developed and refined in an environment which allows the integration of parcel (or institutional) information with natural resource (or environmental) information and physical infrastructure information. If land information systems developed at the local level become primary components in the land information network, and are built to interface with federal systems, then federal agencies may simply gain access to the local systems when and if needed. As a result, federal agencies need not create large databases containing information outside of their primary agency concerns. A long-term program should be initiated by the federal government to demonstrate how local governments and other users can gain efficient access to federal land information. We anticipate that the constituency of land information users will increase as information is made more accessible through the network. In this manner, we believe the network will prove to be an extremely important national resource.

Land information systems which can obtain land information from a wide range of federal sources should be demonstrated at the local level. Standards and models should be tested in programs in geographically and culturally different jurisdictions in order to identify issues common to users across the nation. Instead of pilot projects, these proving grounds should be considered preliminary programs which will be expanded into full-fledged multi-user, multi-purpose programs over time.

These programs must be based on demonstrated land management needs and should primarily involve local governments which have already demonstrated a commitment to improving the management of land information by investing their own resources. The programs should illustrate how local governments can obtain federal land information regardless of their hardware and software. To this end, the local governments should be selected so that they represent a cross-section of users of the most popular commercial GIS technologies. A research team, possibly from an academic community or the private sector, should develop generic interfaces between the



federal land information sources and these leading commercial GIS technologies. The programs should also build on the results and actions of others, for example, the detailed Resource Management Plans developed by the Bureau of Land Management.

These local level programs should formally report on the technical and institutional alternatives considered in integrating their information with that of federal agencies. These programs should also be well advertised throughout the nation and open to inspection so that others may use the knowledge gained to implement their own systems.

#### 6.4 Call for Federal Action

We strongly believe that if such a partnership is to be formed and successfully maintained, it will depend upon the constant leadership afforded by a cooperation among federal agencies charged with managing the land. We see the federal government having two roles. The federal government must provide the leadership necessary to draw together state and local governments, the private sector, and academia into a working partnership. To do this, the federal government must have a clear understanding of the roles and responsibilities of its future partners, and in particular, state and local governments. Secondly, the government must participate in maintaining the partnership once it has been established.

##### 6.4.1 Action as a Leader

Leadership by the federal government is crucial for developing the broad partnership described earlier. Federal agencies whose charters focus on land management or land information must lead the development of:

- o Policy-level responses, e.g., providing institutional support for improved management of land information through broad policy positions in terms of the multiple-use of the land, through policies which foster the growth of the partnership, and through policies which support the development of individual land information systems;
- o Systems-level responses, e.g., specifying, implementing, managing, and evaluating new programs and technologies designed to improve the access, availability, and use of land information; and



- o Technology-level responses, e.g., assessing and developing tools and techniques for the acquisition, analysis, management, and dissemination of land information.

Specifically, attention must be paid to:

a) Establishing a Coordinating Mechanism.

A panel or national committee comprising land information users in federal, state, and local government, the private sector, and academia must be created to coordinate the requirements and activities of agencies participating in programs designed to test and refine standards and procedures.

b) Developing Standards and Models.

Standards relating to hardware, software, data, and applications should be developed from a comprehensive land information management perspective. These standards should relate not only to data transfer and communication formats, but also to aspects of spatial referencing, feature definition, land use classification, and data documentation. These standards must be designed to allow and promote innovation and development, and not to hinder such progress.

The standards developed should be integrated into a parcel-based land information system model that can be applied to publicly and privately owned land. The federal government should encourage the use of standardized models and systems in land information management practices across the nation. Three types of models are required:

- o A multiple-use land management planning model for use by federal, state, and local government agencies, and the private sector;
- o A land information system model that supports decision-making concerning multiple-use of the land; and
- o Model legislation which reinforces land information systems and practices, and which could be used by state and local governments.



c) Improving Access to Information.

Several issues affecting access to information must be addressed:

- o Policies and procedures are needed to facilitate coordination and cooperation required for sharing information, for example, by using the approach of custodians of information, while also ensuring that custodians will have sufficient, continued support to maintain their responsibilities;
- o Policies are needed to guide provision of access by remote terminals. When land information was maintained on paper and stored in manual systems, concerns over the accessibility and subsequent use were restricted to a few sensitive types of information. The capability to rapidly retrieve, compare, and merge different government records while sitting at a single terminal is resulting in a re-appraisal of what constitutes "sensitive" information.
- o Policies and procedures are needed to facilitate an awareness of what information is available for use. A potential mechanism is a network of clearing houses operating at the federal, state, and local levels with a "clearing house of clearing houses" providing information on what is available, from whom, and how it can be obtained.

d) Promoting Communication.

Processes suitable for communicating the goals and strategies of the network must be developed. These processes should be directed towards a wide range of influential audiences.

One possibility is a public symposium at which federal agencies can present progress achieved and their short- and long-term plans. Such communication would enable state and local governments, and the private sector to obtain information which can be used in developing their own plans. Other meetings can focus on specific needs. For instance, symposia illustrating methods of incorporating land information maintained by federal agencies into land information systems of local governments should be well received by local jurisdictions.



Communication processes, however, must extend beyond symposia. Formal lines of communication must be established to provide for continued input and feedback from the participating organizations. Roles, responsibilities, and required actions must be clearly communicated.

e) Promoting Education.

Processes suitable for educating members of all branches of the land information community should be developed. Education on concepts and technologies must cater to the special requirements of land information users from policy-makers to field operatives. For example, cooperative and study programs with universities should be developed to increase the number of well-trained land information and land managers.

f) Promoting Research and Development.

A systematic and long-term program of applied research and development should be instituted. To date, the research and development agenda has been set primarily by independently competing hardware and software vendors and has been articulated primarily in terms of technical issues. There is a pressing need for an agenda that goes beyond the technical issues of geographic information system (GIS) software/hardware development and database building. It is generally acknowledged by LIS users that the primary impediments to effective application of GIS technologies involve institutional, managerial, economic, legal, and other social issues in addition to the technical issues.

A potential mechanism for setting the research agenda is a workshop similar to the 1985 National Science Foundation Workshop on "Fundamental Research Needs in Surveying, Mapping, and Land Information Systems". Such a workshop could investigate the organizational frameworks and relationships best suited to accomplish the primary goals of end users. It could draw together a broad-based coalition of federal, state, and local government users for the purpose of establishing the functional capabilities of systems that will meet the integration and multiple-use needs of all users. It would be a focus through which the user community could also articulate the applied



research and development needed over the next several years, and thereby direct more effectively the activities in the academic and private vendor communities.

#### 6.4.2 Action as a Partner

The federal government must continue to play a key role once the partnership is established. Some actions initiated in the creation phase will continue as needs change and issues are refined:

- o The panel or committee established by the federal government to coordinate activities must become a permanent mechanism for addressing issues facing the broad community of land information users;
- o Standards must be maintained and modified in accordance with changing requirements;
- o Federal agencies must continue to communicate their progress and future plans to enable other partners to develop their own plans; and
- o Clearing houses and other suitable mechanisms for providing access to information must be established and maintained.

## 6.5 Call to Action for BLM

While some communication and collaboration has occurred at the federal level, there has not been enough to provide sustained momentum, much less ongoing leadership and direction for state and local governments, the private sector, and academia. We believe that a catalyst is needed to stimulate and sustain leadership by the federal government. We strongly recommend that BLM serve as that catalyst. Additionally, the Bureau should participate actively as a member of the broader partnership.

### 6.5.1 Action as a Catalyst

BLM has the expertise and resources to serve as a catalyst in promoting land information management. It has demonstrated its ability to bring together diverse groups that successfully implement LIS and land management activities that go well beyond what any single agency or group could have achieved. BLM should serve as that catalyst, collaborating with and engaging other federal agencies. We recommend that BLM undertake the following actions to serve as an effective catalyst. BLM should:

- 1) Establish an Office of Land Information Management. This Office should coordinate BLM's land information management activities over the long-term, first in its role as a catalyst, and then as a partner.
- 2) The Office of Land Information Management should establish two internally-focused task forces, both with a six-month deadline. The Office should notify other federal agencies, as well as other interested parties, about the task forces.

The first task force should:

- o Identify issues which affect the development of Bureau-wide standards relating to hardware, software, data, and applications with particular emphasis on the integration of institutional (parcel-based) and natural resource information;
- o Identify internal educational processes to upgrade land information management knowledge and skills of its personnel. In this regard, BLM should re-assess its educational curriculum so that concepts and



- applications for multiple-use of land and land information systems are communicated to its personnel through vehicles such as the Phoenix Training Center;
- o Identify external educational processes to increase the numbers of well-trained land information and land management specialists available to BLM. Towards that end, these processes should include expanding the Bureau's existing cooperative and study programs with universities and introducing national scholarships for students in the field of land information management; and
  - o Identify the mechanisms required to establish a research agenda.

The second task force should:

- o Identify mechanisms for communicating the concepts of land information management to the entire land information community within BLM; and
  - o Identify obstacles that prevent outside users, as well as those within BLM, from obtaining BLM land information.
- 3) The Office should communicate the findings of the task forces to other federal agencies within two months of completion.
- 4) The Office should use the workshops and forums designed to communicate the results as a base to promote the concept of coordinated leadership by federal agencies.

Beyond these task forces, BLM should build on existing relationships with other agencies and expand on mechanisms such as the 1988 Memorandum of Understanding with the National Oceanic and Atmospheric Administration. BLM has acquired tremendous knowledge and experience in effectively managing multiple-use of millions of acres of U.S. land and resources, and in integrating institutional (parcel-based) and resource information. This knowledge and experience has not been widely publicized. BLM should increase its communication efforts to keep people informed of the work it is doing. The Bureau must share not only its land information, but also information about its LIS.

### 6.5.2 Action as a Partner

We foresee that BLM will play a major role in the partnership given the Bureau's extensive responsibilities for managing land and resources across the nation, and its expertise in managing land information. BLM will be in a position to offer personnel to participate in the various committees and bodies established to guide and manage the partnership. The Bureau will play a key role in all facets of the partnership, for example, establishing a coordinating mechanism, developing standards and models, improving access to information, and promoting communication, education, and research and development.



## 6.6 Closing Statements

The challenge facing the land information management community lies not with building larger databases or developing new information technology, but rather with using information more effectively in the wise management of our land and resources.

Effective management of land information can occur only through a partnership of federal, state, and local governments, the private sector, and academia. This broad partnership can be developed only with leadership by the federal government. A catalyst is needed to stimulate this leadership.

While it is not widely publicized, BLM has acquired tremendous knowledge and experience in effectively managing multiple-use of millions of acres of U.S. land and the resources thereon. It has developed a vision, that has not yet been communicated widely within its ranks, but nonetheless worth pursuing, of a way to integrate innovative multiple-use land management concepts within a multi-purpose, state-of-the-art land information system. BLM has also served as a catalyst on a regional basis to engage government agencies and other groups to work successfully in implementing various facets of improved land management.

BLM, we believe, should continue to pursue all three activities, (i.e., managing land for multiple-use, creating a Land Information System to support multiple-use land management, and serving as a catalyst on a regional basis to improve land management). However, BLM should broaden its horizon to serve as a catalyst among federal agencies. Together, and only together, can they provide the momentum and direction for state and local governments, the private sector, and academia to rally behind. These smaller groups cannot wait any longer; however, their individual efforts at improving land resource management through individual, isolated land information systems will continue to fail. What is needed is a sustained amalgamating effort around which different groups can readily share accurate, consistent information about the land.

BLM has demonstrated its experience in multiple-use land management, its expertise in developing a multi-purpose land information system, and its proven ability to collaborate with other agencies. We believe that BLM has an obligation to serve as a catalyst and active partner in the broader programs necessary to promote better management of land use and land information throughout the United States.

While it is not widely realized, BLM has acquired tremendous knowledge and experience in effectively managing multiple-use of millions of acres of U.S. land and the resources therein. It has developed a vision that has not yet been communicated widely within the ranks, but nonetheless worth pursuing, of a way to integrate multiple-use land management concepts within a multi-purpose, multi-agency land information system. BLM has also served as a catalyst on a national basis to engage government agencies and other groups to work cooperatively in implementing various levels of land use management.

Now, we believe, should continue to pursue all these activities, i.e., managing land for multiple-use, creating a land information system to support multiple-use land management, and serving as a catalyst on a national basis to improve land management. However, BLM should expand its position to serve as a catalyst among federal agencies. Together, and only together, can they provide the momentum and direction for state and local governments, the private sector, and academia to rally behind. These smaller groups cannot wait any longer; however, their individual efforts at improving land resource management through individual, isolated land information systems will continue to fail. What is needed is a sustained, unifying effort around which different groups can readily share resources, equipment, information about the land.



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- o National Parks Service
- o U.S. Geological Survey

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- o Bureau of the Census
- o Charting and Geodetic Services/National Geodetic Survey

U.S. Department of Agriculture:

- o Forest Service
- o Soil Conservation Service

U.S. Department of Defense:

- o Defense Mapping Agency

U.S. Environmental Protection Agency

Federal Emergency Management Agency

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## APPENDIX 1

### Glossary of Terms

Automated Land and Minerals Record System (ALMRS) - The component of BLM's Land Information System which provides information about ownership status, special designations (such as wilderness designations), and use authorizations such as mineral leases, mining claims, and road and pipeline rights-of-way. This data is typically represented on master title plats.

Automated Resource Data (ARD) - The component of BLM's Land Information System which provides information about the natural and cultural resources and characteristics of public land administered by BLM. This data are typically represented in a variety of formats, including maps, tables, charts and reports, such as those showing wildlife habitat or the location of timber sales.

Closed Land States - The 18 public-land states in which the Commissioner's records have been transferred to the individual states. They are Alabama, Arkansas, Florida, Illinois, Indiana, Iowa, Kansas, Louisiana, Michigan, Minnesota, Mississippi, Missouri, Nebraska, North Dakota, Ohio, Oklahoma, South Dakota, and Wisconsin.

Colonial States - The 18 states in the lands of the original Colonial Grants. They are: Connecticut, Delaware, Georgia, Kentucky, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, North Carolina, Pennsylvania, Rhode Island, South Carolina, Tennessee, Vermont, Virginia, and West Virginia.

Federal Interagency Coordinating Committee on Digital Cartography (FICCDC) - A committee mandated by the Office of Management and Budget (OMB) to recommend procedures and programs which will facilitate the coordination of federal agencies' digital cartographic activities and establish and promulgate standards and specifications for the production of digital cartographic data.

Geographic Coordinate Database (GCDB) - The component of BLM's Land Information System which provides the ability to link records and resource data to legal descriptions of land parcels through the establishment of coordinates on Public Land Survey System (PLSS) monuments.

Plat - survey plan showing the bounds of land parcels.

Public Land States - The 30 states formed out of the public domain lands, i.e., those lands turned over to the Federal Government by the Colonial States, and the areas acquired

later from the native Indians or foreign powers. These states comprise the 18 closed land states and Alaska, Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.

Public Land Survey System (PLSS) - The rectangular system of surveys in the public land states which has been in progress since 1785. The PLSS exists in 30 states that cover 80% of the land of the nation.



## APPENDIX 2

### Index of Acronyms

ALMRS - Automated Land and Mineral Record System (BLM)  
ARD - Automated Resource Data (BLM)  
BLM - Bureau of Land Management, U.S. Department of Interior  
FICCDC - Federal Interagency Coordinating Committee on Digital Cartography  
GCDB - Geographic Coordinate Database (BLM)  
GIS - Geographic Information System  
LIS - Land Information System  
NOAA - National Oceanic and Atmospheric Administration, U.S. Department of Commerce  
NRC - National Research Council  
PLSS - Public Land Survey System  
USGS - Geological Survey, U.S. Department of Interior

### APPENDIX 3

#### Project Team for the Land Information Management Study

The Land Information Management Study was undertaken by the BSC Group in cooperation with leading members of the land information management community.

The BSC Study Team was:

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Michael H. Akillian served as editorial consultant for the report.

Lisa Warnecke, Director of Research and Development for the School of Information Studies at Syracuse University, also contributed to the study.



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